Kenya's Water Towers Protection and Climate Change Mitigation and Adaptation (WaTER) Programme

Component 4: Science to Inform Design of Community-Level Actions and Policy Decisions

Establishment of the Status of Wetlands and Springs within Mt. Elgon and Cherengany Hills Ecosystems;

And

Characterization and Development of Models For Conservation and Rehabilitation

Project Report of July 2017

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Cover Photos:

Left - Mascarene ridged frog (Kitale Nature Conservancy). Photo by Victor Wasonga

Right – Papyrus vegetation in Kingwal Swamp. Photo by Philista Malaki

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N/B All the photos were taken during the field survey by the team and one camera had a setting of month (05) coming before the date.

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List of Acronyms

AIS	Alien Invasive Species
CBD	Convention for Biodiversity
CAACs	Catchment Area Advisory Committees
DEM	Digital Elevation Model
DPSIR	Driving force, Pressure, State, Impact and Response
DRSRS	Department of Remote Sensing and Resource Survey
GDEM	Global Digital Elevation Model
GLCF	Global Land Cover facility
GoK	Government of Kenya
GIS	Geographical Information System
IBA	Important Birds Area
IUCN	International Union for Conservation of Nature
KARI	Kenya Agricultural Research Institute
KALRO	Kenya Agricultural and Livestock Research Organization
LULC	Land Use Land Cover
MECDP	Mount Elgon Conservation and Development Project
MEICDP	Mount Elgon Integrated Conservation and Development Project
NASA	National Aeronautic and Space Administration
NDVI	Normalized Difference Vegetation Index
NEMA	National Environment Management Authority
NIR	Near Infrared
NMK	National Museums of Kenya
OECD	Organization for Economic Co-operation and Development
RGB	Royal Botanic Garden
WRMA	Water Resource Management Authority
WRUAs	Water Resource User Associations

EXECUTIVE SUMMARY

Introduction

This report provides the findings and recommendations from a study commissioned by Kenya Forestry Research Institute (KEFRI), to establish the status of Wetlands and springs within Mt. Elgon and Cherengany Hills Ecosystems, to characterize and develop models for Conservation and Rehabilitatio. A multidisciplinary team of 5 experts was constituted to generate information from both desktop and field observations to achieve the target objectives. The expertise involved included ornithologist, herpetologist, wetlands specialist, spatial analyst and plant taxonomist. Information gathered from the surveys was used to characterise wetlands based on the current observed conditions e.g. size and condition of wetlands, threat status of biodiversity observed, wetland use, land use around and within the wetlands among other variables.

Project Description

Mt Elgon and Cherengany hills ecosystems are among the five Water Towers in Kenya. Both ecosystems are situated in Western Kenya. The ecosystem forms the catchment for major rivers draining into L. Turkana and L. Victoria. Other numerous, wetlands, rivers and springs find their sources from the two catchments which cover 11 counties in western Kenya. The catchment support critical ecosystem function in supporting biodiversity and sustaining local community livelihoods. However, reports from studies indicate that these water catchments are gradually being degraded. This has subsequently led to siltation,increased suspended solids and reduced water levels in rivers, lakes, wetlands and springs.

Given the fragility of wetlands and springs in these region, there is need to strike a balance between the ecosystem functions supported by the wetlands and their role in sustaining local community livelihoods. It is therefore imperative that best managementpractices that guide sustainable use and conservation of these wetland resources are developed. The purpose of the current study therefore is to establish the status of Wetlands and springs within Mt. Elgon-Cherengany Hills Ecosystems with a view to charactering and develoing models for Conservation and Rehabilitation purposes.

Overall Finding

Findings from both desktop and field observations indicate that both Mount Elgon and Cherengany Hills ecosystem support critical terrestrial and wetland habitats in addtion the much needed ecosystem functions e.g Nzoia River drains to Lake Victoria through a system of swampy valleys in Uasin Gishu and Trans- Nzoia. The different habitats support important biodiversity ranging from birds, mammals, reptiles and amphibians, plants among other biodiversity. The flagship bird species for these wetland ecostems is the Grey Crowned Cranes. This is a, species of conservation concern globally, since their status have been recently uplisted to Endangered category by IUCN. There populations are under pressure mainly due to wetland habitat degradation.

The wetlands visited were mainly characterized by rivers, springs, swamps and dams. The wetlands range from various sizes and are also under different management systems. The management ranged from communal, private and government to open access wetlands consequently exhibiting varying levels of threats and biodiversity importance. Different land use systems were noted within and outside the wetland. These included mainly farmlands. Both ecosystems are located in high agricultural potential area with farming ranging from small to large scale mechanized farming systems. Our findings reveal that expansion of farmlands is by far the greatest driver of land use changes in the region and the escalating human population. These have resulted in degradation and fragmentation of wetlands due to clearing and draining wetlands to open up areas for farming and grazing activities. However, other causes for wetland/spring degradation were also identified such as unsustainable use of wetland vegetation, excessive water abstraction, siltation of the wetlands due to soil erosion besides lack of respect for existing laws leading to wetlands being converted into private property.

Overall Conclusion

A significant number of wetlands in the Mt. Elgon-Cherengany ecosystem face considerable threat from human activities yet they have no formal protection. This therefore places them at a greater brink of extinction. Some of the activities posing threats include industrial pollution, untreated sewage disposal, agricultural run-off from pesticides and agriculture (e.g. in Nzoia

River), excessive water abstraction for irrigation, damming or drainage (e.g in Yala Swamp), for large scale agriculture and settlements and siltation of rivers arising from soil erosion in degraded watersheds. Other notable threats include Grazing within the swamps and over havesting of papyrus for craft industry, conflicts of open access to wetlands leading to users setting fires to the vegetation and demarcation as private property was also noted.

All the springs visited were set up and protected for use by local communities in the early 20th century by colonial government and have been used over time with not much rehabilitation efforts. Their conditions are in disrepair with minimal water trickling through. The communities are however, still using them and they all wished to have them rehabilitated to enhance the water flow for their domestic use, especially in areas where these are the only sources for drinking water.

Most of the threats identified are tied to pressing issues of human well-being and livelihoods. Effective wetland conservation in the region therefore, will depend on providing solutions for the pressing human livelihoods and well-being. Consequently, for long term conservation efforts to be successful, efforts must enroll the support of people living around protected areas and be seen to be addressing some of their livelihood concerns. Law enforcement and promotion of wise use of the wetlands within the catchment areas is critical for sustainability.

Recommendations

In view of the observations made during this study a series of recommendations are proposed for further action. These include:

i) Laws, Regulations and Policies

Considering that the study area is located in high agricultural potential area with farms ranging from small to large scale mechanized farming systems, and that the expansion of the farms is by far the greatest driver of land use changes in the region coupled by the escalating human population, it is imperative that matters of law enforcement have to be taken seriously to safeguard the wetlands and their catchments. As captured in this study Kenyan laws and policies are very clear on the status and place of wetlands in the environment but from our study it is clear that the law has not been enforced effectively on the ground. We further recommend that

avenues be created so that a comprehensive review, harmonisation, application and enforcement of policies, legislations, regulations and standards governing wetlands and their catchments is undertaken for effective conservation of these critical ecosystems to take place.

Related to this, it is highly recommended that the relevant Ministry finalises the development and release of the "*National Wetlands Conservation and Management Draft Policy, 2013"* for public use. The current draft has very powerful statements which could go along way in strengthening wetland conservation in the country. The following four statements extracted from the draft, attest to this:The Government shall:

Policy Statement 1: Ensure that any drainage, conversion, burning, alteration of a wetland, or introduction of alien and invasive species in a wetland will be subjected to approved standard procedures including Environmental Impact Assessment (EIA), Strategic Environmental Assessment (SEA), Cost Benefit Analysis (CBA), and adequate public participation.

Policy statement 2: Promote restoration and rehabilitation of degraded wetlands.

Policy Statement 3: Undertake socio-economic valuation of wetlands to inform planning and decision making.

Policy Statement 4: Harmonize wetland riparian (buffer) zones and setback limits for all wetland ecosystems in the country.

ii) Waste and Effluent Disposal

Wetlands in or near urban centers were often times found to be in use as waste (solid or liquid) disposal sites. It is recommended that urban and industrial waste management adhere to proper disposal and sanitation systems to protect those wetlands that are in their neighbourhood. Furthermore, local government authorities should develop special programmes to protect these sites from encroachment and use as dumpsites. This would go a long way in strengthening enforcement of existing laws, governing solid and liquid waste management. Construction and use of man-made wetlands for cleaning up toxic elements from effluents before discharging into streams should also be encouraged.

iii) Soil Erosion and Land degradation

Signs of erosion activities such as rills and galleys on land near wetlands or on river banks were observed. Soil erosion is a threat because it destroys riparian areas where vegetation occurs thus opening up the wetland for subsequent sedimentation and siltation. Most of the springs visited during field survey had minimal water trickling through due to silted reservoirs. It is therefore recommened that appropriate technologies be applied to reduce on soil erosion and silting of the wetlans and springs. Technologiesthat have been identified in this study include: Promoting *agroforestry around the catchment,* contouring with vegetative (e.g nappier grass) barriers, contouring with earth banks and waterways, tillage practices such as sub-soiling, improved farming (cropping) systems, vegetative ground cover, mulching and manuring.

iv) Rehabilitation of Springs

All the springs visited were constructed and protected for use by local communities in the early 20^{th} century by colonial government and had been used decades with not much rehabilitation efforts. Their conditions were observed to be in disrepair with minimal water trickling through. The communities were however, still using them and they all wished to have them rehabilitated to enhance the flow of water for their domestic use, especially in areas where these were the only sources for drinking water. It is recommnded that a spring rehabilitation programme be initiated by relevant government structures to restore the springs for local use.

v) Education and awareness

The old adage "***information is power***" remains true even in the current setting. Empowering local communities, especially the youth and women, with education and awaresss of the value of wetlands and their sustainable use, therefore, will go a long way in preserving these valuable ecosystems. A follow-up series of public awareness and education campaigns to sensitize the local communities on the importance of the two ecosystems could change attitudes and perceptions. Patnerships with local CBOs, NGOs, International organizations with a local presence is therefore highly desirable for awaress creation, local management and subsequent conservation of these wetlands and springs.

vi) Alternative Livelihoods

The study recommends identification and promotion of alternative livelihoods through small to medium size enterprises that are necessary for sustaining ecological quality of wetlands. This will check the over-reliance on natural wetland resources. The example of Dunga Ecotourism Project in Kisumu presents a successful story for sustainable use of wetland resource that focuses on improving livelihoods while preserving biodiversity. Public awareness of the benefits of biodiversity conservation coupled by adoption of wetland user-friendly alternatives, and sustainable income generating enterprises offers a unique opportunity to sustainably manage and conserve wetlands amidst increasing population, poverty and limited resources. Observations were made of diverse income generating activities based on wetland resources which currently appear to be a threat to the conservation of wetlands, such as massive harvesting of papyrus vegetation for handicraft industries. Such activities can be turned around to be a point of entry in educating and training the locals on sustainable and wise use of these valuable resources. Furthermore, other nature based enterprises such as Bee keeping, butterfly farming, sustainable fish farming, silkworm farming, etc could be promoted in all the counties.

SECTION I

ESTABLISHMENT OF THE STATUS OF WETLANDS AND SPRINGS WITHIN MT. ELGON AND CHERENGANY HILLS ECOSYSTEMS

CHAPTER ONE: INTRODUCTION

1.1 Project Background

Wetlands are defined under the Ramsar Convention (1971) as "areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters". According to National Wetland Management and Conservation Policy of Kenya (2013), wetlands are defined as "areas of land that are permanently or occasionally water logged with fresh, saline, brackish, or marine waters, including both natural and man-made areas that support characteristic plants and animals, the depth of which at low tide does not exceed 6 meters. These include swamps, marshes, bogs, shallow lakes, ox-bow lakes, dams, riverbanks, floodplains, rice paddies, water catchment areas, fishponds, lakeshores and seashores". They also include coastal and marine wetlands such as deltas, estuaries, mud flats, mangroves, salt marshes, sea grass beds and shallow reefs. These wetlands occupy about 3% to 4% of the land surface, which is approximately 14,000 km^2, and fluctuate up to 6% during the rainy seasons. Wetlands are highly dynamic and fragile ecosystems which are continuously undergoing natural modifications associated with ecological disturbances, droughts, global warming and changes in sea level, deposition of sediments or in-filling with organic materials.

These valuable ecosystems provide goods and services to the society. Some of the provisioning services include, 1) supply of water which is an essential component upon which countless plants and animal species depend for existence and survival, 2) maintaining natural ecosystem by supporting large concentrations of fish, mammals, variety of birds, amphibians, reptiles and other species of invertebrates, 3) provide a number of economic benefits such as leisure, amusement and tourism opportunities, supply water, grounds for fisheries, agriculture and timber production (Macharia et al 2007). Wetlands are among the world's most important natural resources but on the contrary, they are least understood and most abused assets (Maltby and Barker, 2009). For centuries, wetlands were considered as wastelands only fit for reclamation and disposal of waste. Throughout human history, wetlands have been reclaimed for agriculture in many parts of the world (Verhoeven and Setter, 2010). Wetland ecosystems reclaimed in this way have lost much

of their character, leading to reduced biodiversity and reduced performance of functions other than crop productivity (Hassan et al., 2005).

Over the last century, wetlands continue to decline globally, both in area and in quality (Barbier et al 1993, Gardner et al 2015). In Kenya, these declines have been attributed to anthropogenic activities such as pollution from agricultural land and over-exploitation of wetland resources through overfishing, deforestation and catchment destruction, and water abstraction (Macharia et al 2007). The disappearance and degradation of wetlands, unfortunately, comes with adverse consequences including loss of ecosystem services that sustain livelihoods in these areas. Wetlands are among the most productive ecosystems due to their ecological functions and services they offer human being. They are essential to the local communities and Kenya's economy as they contribute significant economic and social benefits to the country. Despite their high productivity and provision of many benefits, wetland ecosystems in Kenya are still facing serious threats including; unsustainable use of wetland resources through overgrazing, over cultivation, over abstraction of water for domestic use, agriculture and industrialization as well as illegal and improper fishing practices (Becker et.al. 2014).

Five main water catchment areas (Water Towers) in Kenya, the Mau Complex, Mount Kenya, Cherengany hills, Aberdares ranges and Mount Elgon, are the source of many rivers and streams flowing into the major types of rivers and wetlands downstream in Kenya. Recent reports from the Ministry in charge of the environment indicate that these water catchment areas have been severely degraded over the last few decades and factors leading to this degradation include rapid population growth, expansion of agricultural land, climate change, poor governance, inappropriate land use practices and limited appreciation of the value of a healthy environment in supporting quality life (GoK 2012). The degradation and destruction of the concerned ecosystems result into siltation and increased suspended solids and reduced water levels in rivers, lakes, wetlands and springs downstream.

Mt Elgon and Cherengany Hills form an important trans-boundary ecosystem between Kenya and Uganda, housing unique biodiversity distributed across diverse habitats over a mountain gradient. It is covered by about 180,000 ha of forest which is the catchment for major rivers draining into L. Turkana and Victoria. By extension this ecosystem forms part of Nile basin

catchment and therefore support Millions of people around L. Victoria, Turkana, Kyoga and associated rivers. The ecosystem is characterized by a montane forest, wooded grassland, bamboo, alpine moorland and wetlands which underpin its rich and unique biodiversity. Like other mountain ecosystems, it has moderated climate and resources that constantly attract human exploitation. Consequently mountain ecosystem has been subjected to encroachment and degradation particularly on the lower slopes, threatening existence of both species and ecosystem services.

Mt. Elgon is the fourth highest mountain in Africa with a peak of 4320 m.a.s.l. It is located on the Western Kenya and Eastern Uganda international boundaries. It covers 11 counties in Kenya, namely; Trans Nzoia, Busia, Bungoma, Elgeyo Marakwet, Kakamega, Kisumu, Nandi, Siaya, Vihiga and Uasin Gishu and three districts in Uganda, namely Kapchorwa, Sironko and Mbale. It lies at latitude 1° 08' N and longitude 34°45'E and receives an annual precipitation of 1280 mm and minimum and maximum temperatures of 9°c and 22°c respectively. Settlement patterns have changed over time leading to integration of indigenous peoples and immigrant communities. The immigrants have influenced the local communities who were primarily livestock herders to be agriculturists. This change in the lifestyle of the people has led to encroachment of the forest for cultivation and exploitation of the forest products. The forest has been subjected to over-exploitation of high value commercial tree species such as Elgon teak (*Olea welwitschii*), especially in the natural forest. Over the past 50 years, the forest cover and the tree density has decreased due to extensive clear felling of plantations without re-planting by large timber processing companies. There is also uncontrolled utilization of forest resources, such as illegal harvesting of high value trees by an increasing number of forest users.

Cherengany Hillls, on the other hand, are a series of hills with natural forests and plantations forming the westrn escarpment fo Kerion Valley, spanning across West Pokot, Elgeyp Marakwet and Tranzoia counties . The hills range fom 1,900 to 3,000 a.s.l. Threats currently facing the hils include encroachment, high water use, illigal logging, charcoal burning, firewood collection, illegal grazing and cultivation among others.

Mt. Elgon-Cherengany ecosystem vegetation can be zoned into four; namely open woodland, tropical moist forest, bamboo and afro-alpine zone that is above the bamboo zone. *Juniperus*

procera, *Hagenia abyssinica*, *Olea welwitschii*, *O.hotstetteri*, *Prunus africana*, *Podocarpus falcatus* and *P. latifolia* dominate the moist tropical forest. Moorlands, swamps and rocks form a major part of the afro-alpine zone(Ongugo et al., 2008). The major land cover in Mt. Elgon forests on the Kenya side is classified as indigenous forests, mixed forest/bamboo, bushland, grassland etc. *Neoboutonia macrocalyx* and *Podocarpus latifolius* are the most widely distributed tree species (Muchiri et al., 2001).

Mt Elgon Ecosystem has a dual gazettement as a national park (108km^2) and a forest reserve (609.6km^2) (Cameron et. al. 2000). According to Birdlife International (2017), both Mt. Elgon and Cherengany ecpsystems are internationally recognized as Important Bird Areas (IBAs). The avifauna of the Cherengany is characteristic of the highland forests of Kenya west of the Rift Valley, comprising both central highland species and western species. Ecological surveys have recorded over 73 forest-dependent species. Regionally threatened species include *Gypaetus barbatus* (one of the last breeding populations in Kenya, nesting on the high peaks), *Stephanoaetus coronatus* (widespread in small numbers), *Glaucidium tephronotum* (recently recorded in Kapkanyar), *Campephaga quiscalina* (uncommon and local; recent records from Kapkanyar) and *Indicator conirostris* (uncommon). On the other hand, Mt Elgon has a rich montane avifauna. The wooded grasslands on the north-eastern side hold a number of unusual birds, including the Sudan–Guinea Savanna biome species that all have very restricted ranges in Kenya. Nineteen of Kenya's 43 Guinea–Congo Forests biome species have been recorded, although as many as 10 of these may now be extinct.

1.1.1 Pressure/threats to key Biodiversity

The condition of many of the remaining forest blocks in the Mt Elgon-Cherengany Hills ecosystems is relatively good, as indicated by the presence of many forest-dependent bird species. The wetter, western block is especially intact. Nonetheless, there are a number of serious conservation problems. These include encroachment, de-gazettement for settlement, poaching of trees for building or charcoal burning, livestock grazing, and tree-felling by honey gatherers (for honey, or for manufacturing bee hives). Occasional fires, possibly started by honey gatherers, also occur—one destroyed hundreds of hectares in Kapkanyar forest in 1986. Most of the lower

slopes of Kapolet forest have been converted to farmland in the last 20 years, and similar threats face most of the forest blocks: subdivision and clearance of Kiptaberr forest, facilitated by an unscrupulous Forest Department employee, was recently halted just before clear-felling began. Grazing is a major concern, especially in Kapkanyar, which borders land occupied by the pastoralist subgroup of the Pokot people. Hundreds of cattle are left to roam in the forest for the entire dry season period, causing enormous damage. As the population outside the forest increases, pastureland diminishes and pressure on the forest rises. Currently the small-scale farmers graze their cattle in pastureland outside the forest. Embotut forest.

The Mount Elgon forest has suffered severely from encroachment on the lower slopes: very little lower-altitude forest remains, and a number of forest bird species formerly known from below 2,000 m are almost certainly extinct. The forests contain valuable timber, in particular *Olea capensis*. Illegal timber extraction and (more recently) licensed commercial logging by Rai-Ply, an Eldoret-based company, have done tremendous damage to the forest structure. The recent, apparently uncontrolled devastation of substantial areas by a commercial concern has been severe enough to spark protests and demonstrations by those living around the forest. Mount Elgon faces similar management problems to most other forests in Kenya, with the Forest Department finding difficulties in controlling fuelwood collection, fires set by honey hunters, collection of poles, debarking of medicinal trees, and forest grazing. The moorland has also suffered damage from fires set during drought periods, though there is evidence that some of the vegetation communities there are fire-maintained. The wooded grasslands on the north-east are an unprotected and undervalued habitat whose special birds are in imminent danger of disappearing, as expansion of cultivation and destruction of habitat continue apace. The mountain lies across the international border, which has made it difficult to control the poaching of large animals on the Kenyan side, and organized smuggling has at times created a security problem, deterring visitors to the National Park. This is unfortunate, because the mountain has many attractions. The moorland and peaks have great scenic beauty, the caves and their elephant visitors are fascinating, and a wide range of mammals, birds and vegetation can be seen during a short visit. Surveys are needed to: establish the status of *Macronyx sharpei* on the moorland, and the effects of seasonal burning on this species; map out the wooded grassland and assess the populations of Sudan–Guinea Savanna biome species; and assess the current status of all the

forest birds. In the meantime, commercial logging in the forest should cease. An integrated management plan for Mount Elgon is needed that will take into account the conservation requirements of all its habitats, develop the mountain's enormous potential for ecotourism, and put the interests of local people and sustainable use of resources above destructive, short-term exploitation. An IUCN-managed conservation and development project is presently starting to address these concerns.

1.2. Purpose and & Objectives of Study

The purpose of the current study is to establish the status of Wetlands and springs within Mt. Elgon and Cherengany Hills Ecosystems, characterize and develop models for Conservation and Rehabilitation. Given the fragility of wetlands, there is an urgent need to strike a balance between the environmental functioning of wetlands and their sustainable use for livelihoods. It is therefore imperative that management regimes that guide the use, conservation and sustainable management of wetland resources in Kenya are developed. Considering that Kenya already has a very comprehensive Master plan for its water catchment areas (GoK, 2012) the proposed study will go a long way in providing detailed conservation strategies with empirical data as well as decision making tools for the conservation and management of wetlands in Mt Elgon and Cherengany Hills portion of the national water towers.

1.2.1. Specific Objectives:

a) To review existing scientific literature and reports on wetlands and springs in the study area.
b) To map the wetlands and springs within the two ecosystems using satellite imagery.
c) To verify wetland delineation in the field through ground surveys using various recognized wetland indicators, such as the presence or absence of hydrophytes (plants that grow only in water or very wet soil), hydromorphic soil features and topographic indicators.
d) To determine the conservation status of the affected wetlands, with reference to the presence of alien species, ploughing / agriculture etc. Define level of existing impact on wetlands in terms of natural, transformed and critically transformed.

e) To carry out a desk study of agro-forestry and soil conservation technologies for rehabilitation and make recommendations.

1.2.2. Scope of Study and Study Site

Mt. Elgon forest ecosystem is located on the steep slopes of the extinct volcano Mt. Elgon (height of 4321 m a.s.l.), on the Kenya–Uganda boarder. The forest is between 0849'–18130 N and 348050 –348470 E, and covers approximately 78,025 ha stratified into National Park, high closed canopy natural Forest Reserve, open area of bush and grassland, and plantations(Hitimana et al., 2004).

Figure 1 below shows the setting of the study area which is comprised of 11 counties in the western part of Kenya namely: Trans Nzoia, Busia, Bungoma, Elgeyo Marakwet, Kakamega, Kisumu, Nandi, Siaya, Vihiga, Uasin Gishu and West Pokot. The region especially, Uasin Gishu and Trans Nzoia is considered the bread basket for the country.

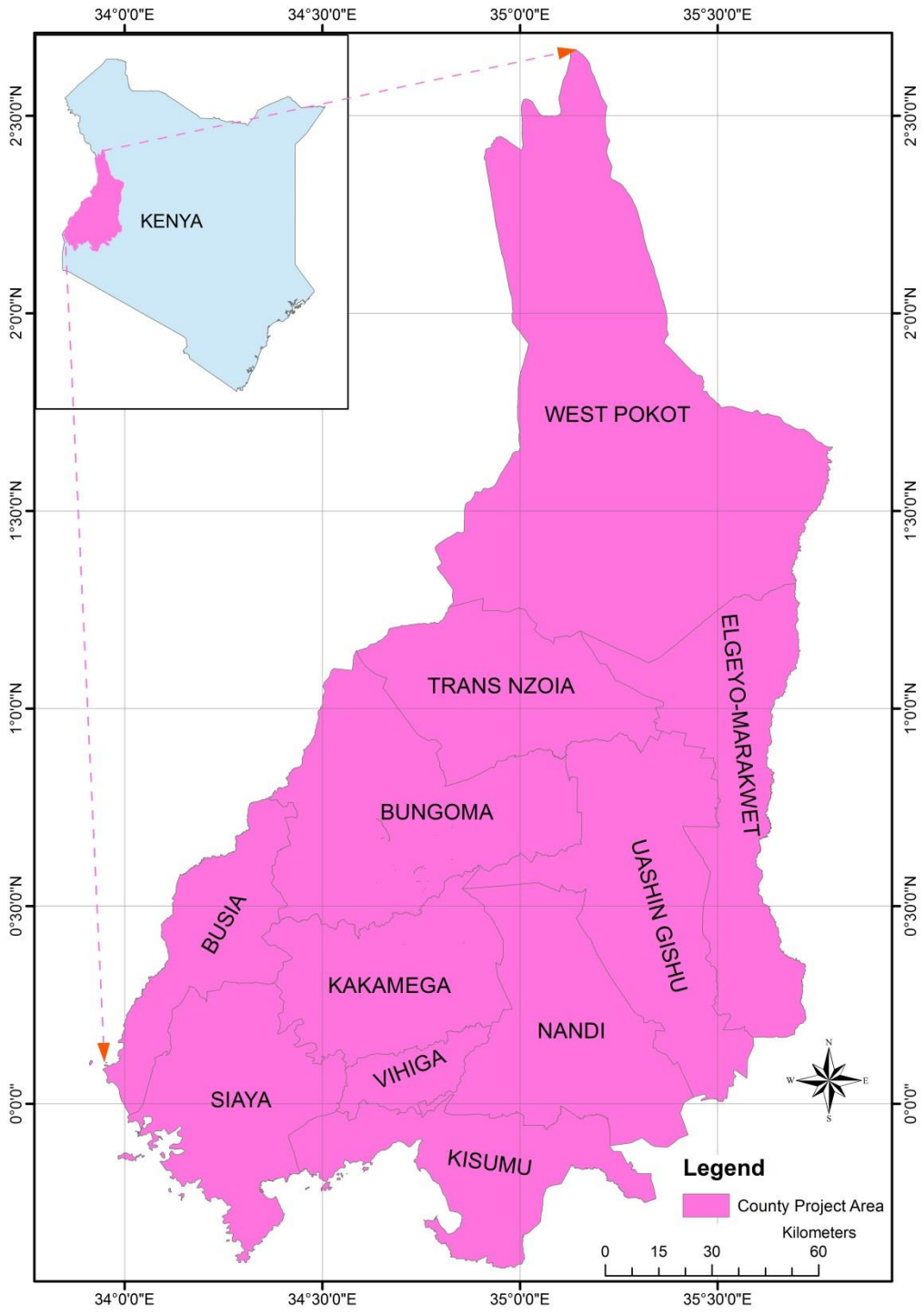


Figure 1: The Study Site location

CHAPTER TWO: STUDY APPROACH AND METHODOLOGY

In line with the ToR for this consultancy, a combination of desktop review, field surveys and interviews were used to gather the required information towards the establishment of the Status of Wetlands and Springs within Mt. Elgon and Cherengany Hills Ecosystems: Characterization and Development of Models for Conservation and Rehabilitation

The approach and methodology adopted by the Consultant involved:

- Participatory approach (identified key stakeholders, engagement with policymakers)
- Consultative approach (regular meetings with Client and any other stakeholder where appropriate)
- Scientific approach in the data collection and analysis (both quantitative and qualitative) e.g.
    a) Quantitative Data gathered on physical environmental trends e.g. climate, soil and geological activities, hydrological trends, land use, vegetation, biodiversity, etc.
    b) Qualitative Information was derived from interviews, observations and questionnaire administration (**Appendix I**)
    c) Field observations to identify biodiversity ranging from different taxa groups utilising the wetlands e.g. birds, mammals, reptiles etc

    Data Analysis including modeling where appropriate

2.1. Sampling Frame & Selection of wetland for ground-truthing

The spatial assessment of wetlands was guided by the process of identification of wetlands from Satellite images. Landsat 8 Satellite imageries was acquired at the peak of dry season. The dates of the satellite imageries chosen are for the months of January and February. The rest of the details are as shown in the table below.

PATH	ROW	DATES
169	059	20170117_20170311
169	060	20170117_20170311
170	058	20170209_20170217

170	059	20170209_20170217
170	060	20170209_20170217

Due to the limited time frame and the vast geographic area to be covered by the study, sample wetland sites were prioritized to guide on ground field assessment. Selection of fourty seven potential sites for conducting ground-truthing (validation) was performed using GIS random selection of wetland layer in QGIS environment. The wetland layer was acquired from online database, identification from Google Earth and use of satellite images.

Random selection was based on county boundary extent (polygon), **selecting 6 wetlands** from evey county. Wetlands which were within 1 km euclidean distance from the main road were the ones prioritised for surveys. A further random selection was done on the ground to ensure heterogeneous sampling of wetlands based on observed characteristics.

Few counties such as Vihiga and Kakamega had small wetlands that could only be identified using high resolution satellite image. hence other approaches were employed to locate potential locations for the wetlands. These approaches included locating areas where roads passes over small streams. Another approach was generating headwaters of streams from the drainage system. Most headwaters of streams have a well formulated springs or wetland with vegetation through which water is discharged to the stream channels.

Well studied wetlands with sufficient information on biodiversity and conservation such as Yala wetlands were not considered for ground-truthing and investigation. Information on such wetland was generated from literature reviews.

Potential springs and wetlands identified through this process are as shown in the maps below.

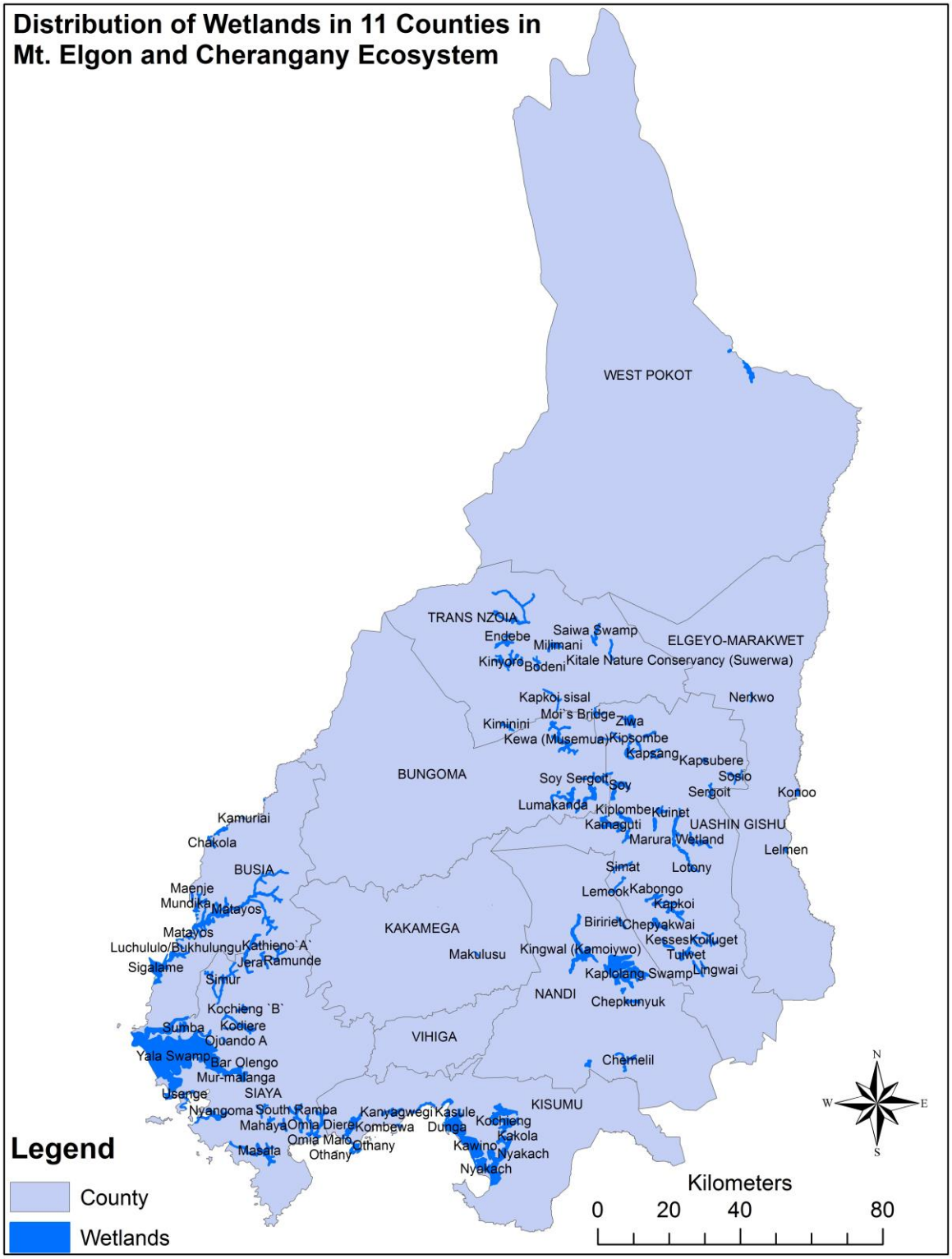


Figure 2: Distribution of Wetlands (>1ha.) in the 11 counties

Potential springs were generated from the headwaters of drainage basins. Major drainage channels has headwaters from which water is discharge. These points define almost the upper point of the river or streams. Validation of the proportion of the generated points on the ground confirmed 100% of the points had springs. The precision of the location of the spring points were 100-150m away. Local residents guided to exact positions of the springs.

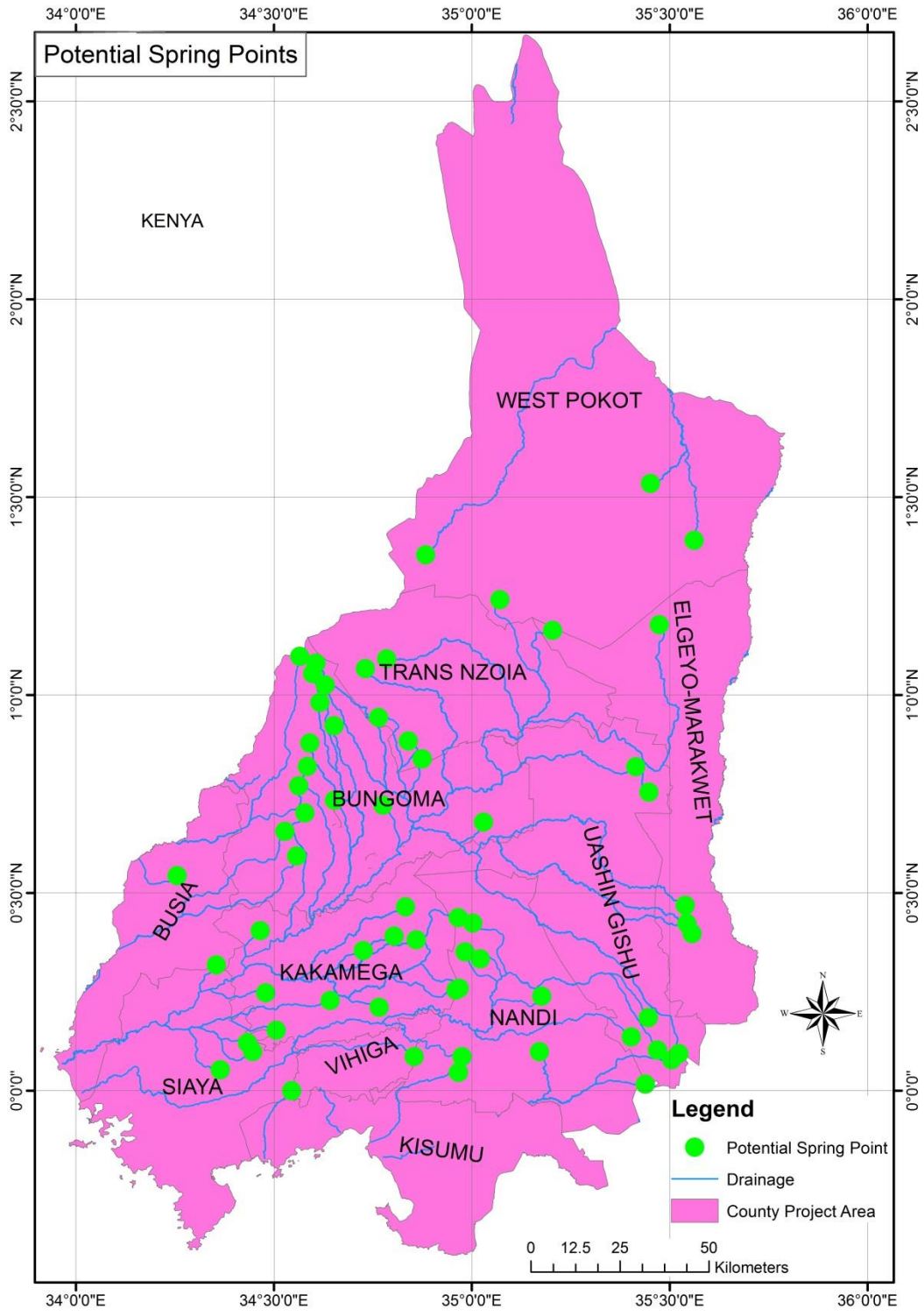


Figure 3: Potential Spring Points in the study site

Figure 4 below was generated to provide an overview of the drainage system in the study area.

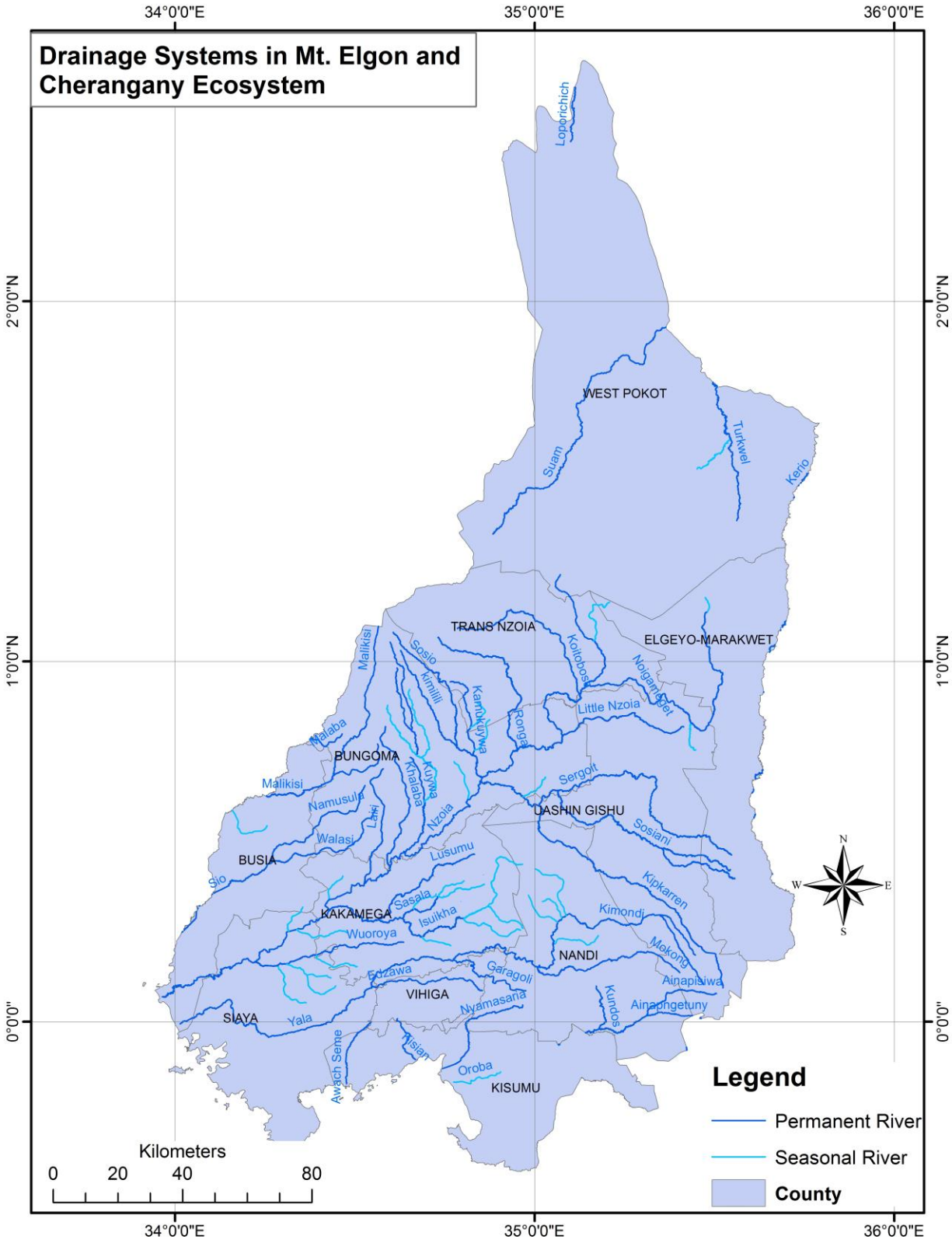


Figure 4: Drainage System of the Study area: Perment and seasonal rivers

Selected wetlands were ground truthed in ten counties covered by Mt. Elgon and Cherengany Ecosystems. Sub-basins of each ecosystem was used as the main criteria for wetland selection for validation in each county. All selected and validated wetlands were characterized based on existing biodiversity, topographic featues and socio-economic uses.

2.2. Field Survey

A field visit was undertaken between 2nd and 10th May 2017 by a team of 6 experts comprising of the Team Leader, GIS and Modeling Expert, Biodiversity experts (birds, mammals and reptiles), Aquatic Expert, Ecologist and Sociologist. Selected wetlands were visited in ten counties namely; Trans Nzoia, Busia, Bungoma, Elgeyo Marakwet, Kakamega, Kisumu, Nandi, Siaya, Vihiga and Uasin Gishu. The team was not able to visit Wets Pokot County due to security reasons.

A B

Plate 1: A) Wetland in Trans Nzoia and B) Spring in Kakamega county

During the field visit a total of 50 wetlands/spring sites were visited in ten counties namely; Trans Nzoia, Busia, Bungoma, Elgeyo Marakwet, Kakamega, Kisumu, Nandi, Siaya, Vihiga and Uasin Gishu. Due to insecurity reasons West Pokot county was not visited. Some of the sites visited as guided by google maps generated above had their wetlands all converted into farmlands and hence there was no more wetland on ground-truthing. This was quite a common occurrence in Kakamega and Nandi counties. All the springs visited were set up and protected for use by local communities in the early 20th century by colonial government and had been used

over time with not much rehabilitation efforts. Their conditions were in disrepair with little water coming through. The communities were however, still using them and they all wished to have them rehabilitated to enhance water flow for their use.

Within the sites and counties visited the study team interacted with the following stakeholders among others:

- Local Farmers (both men and Women)
- Kenya Wildlife Services (KWS)
- Community Water Management leaders
- Water Management Authorities
- Schools (Teachers and Pupils)

The purpose of the field visit to the study area was to get some primary data and information on the status of selected sample wetlands and springs in the area. The team also took time to interact with various offices and Government Departments to establish the presence and availability of Data and Information that could facilitate the implementation of the current study.

2.3 Fieldwork/Collection of Baseline Data/Information

The field work facilitated the collection of the following data/information:

- Socio-economic data including wetland/springs use and perception
- River hydrology and wetlands;
- Flora (existing wetland vegetation and surrounding areas)
- Fauna (focusing mainly on wetland indicators e..g birds, amphibians, mammals)
- Land use
- Georeferencing

Table 1. List of wetlands sampled during the field work in May 2017

Place	Latitude	Longitude	Sublocation	Location	County	Wetland Type	Land Use
Malakisi River	0.6172	34.23455	Akiriamasit	Amoni	Busia	Swamp	Agriculture, Settlement
Akiriamas wetland	0.62074	34.22035	Akiriamasit	Amoni	Busia	Swamp	Agriculture, Settlement
Rafiki Farm	1.00393	34.97174	Matisi	Matisi	Trans Nzoia	Swamp	Agriculture, Water abstraction
Matisi Wetland	1.00731	34.97978	Matisi	Matisi	Trans Nzoia	Swamp	Agriculture, Settlement
Miti Jambazi	1.05211	34.99991	Bidii	Kibomet	Trans Nzoia	Swamp	Brick-making, Farming, Settlement
Chebera II	0.87084	35.50343	Chebiemit	Moiben	Elgeyo Marakwet	Dam	Agriculture, Settlement
Chebera Dam	0.88235	35.49624	Kilimani	Moiben	Elgeyo Marakwet	Dam	Water abstraction - urban supply
Chebiemit Wetland	0.8884	35.50531	Chebiemit	Moiben	Elgeyo Marakwet	Swamp	Agriculture, Settlement
Moiben River	0.93947	35.51279	Cheptongei	Kuserwo	Elgeyo Marakwet	Swamp/River	Agriculture,grazing, Brick making
Mwera spring	0.3775	34.85092	Mwera	Kabras South	Kakamega	Spring	Agriculture, Settlement
Shilongo Wetland	0.3776	34.85092	Mwera	Kabras South	Kakamega	Swamp	Farming, settlement
Lunyu Spring	0.383	34.79695	Shianda	Kabras South	Kakamega	Spring	Farming, settlement
Lukala Wetland	0.47093	34.82437	Matioli	Kabras Central	Kakamega	Swamp	Farming, settlement
Kobura Irrigation Scheme	-0.17124	34.90722	Lela	Kombura	Kisumu	Rice Puddies/River	Farming, settlement
Kimondi Swamp	0.27971	35.07582	Chepkober	Kapsisiywa	Nandi	Swamp	grazing,growing crops
Kaplolong swamp	0.21672	35.19662	Arwos	Arwos	Nandi	Swamp	grazing ,growing trees
No Name	1.05879	35.05143	Amuka	Kaisagat	Trans	Swamp	Agriculture, Settlement

					Nzoia		
No Name	1.06003	35.05015	Amuka	Kaisagat	Trans Nzoia	Swamp	Agriculture, Settlement
Matunda Wetland	0.8234	35.12611	Kongoni	Kongoni	Bungoma	grassy marshes	Farming
Turbo Wetland	0.68207	35.0389	Mbagara	Mautuma	Bungoma	Papyrus/ Springs	Grazing, Plantation
Sio River Wetland	0.38195	34.14324	Mundika	Bukhayo West	Busia	Swamp	Water abstraction, Farming, Grazing
Sergoit Wetland	0.68954	35.4124	Sergoit	Sergoit	Uasin Gishu	Swamp	Agriculture, Settlement
Kamelilo	0.68979	35.41215	Sergoit	Sergoit	Uasin Gishu	Swamp	Agriculture, Settlement
Sosiyo	0.73867	35.45345	Sosio	Karuna	Uasin Gishu	Swamp	Agriculture, Settlement
Kimwani Wetland	0.00958	35.19378	Kimwani	Chemilil	Nandi	Swamp	Agriculture, Settlement
Keboswa Dam	0.0989	35.23258	Taito	Siret	Nandi	Dam	Wetland
Taito Dam I	0.09942	35.23088	Taito	Siret	Nandi	Dam	Agriculture, Settlement
Taito Dam II	0.10098	35.22722	Taito	Siret	Nandi	Dam	Agriculture, Settlement
Kapkorio Dam	0.10536	35.22039	Kapkorio	Tartar	Nandi	Dam	Agriculture, Settlement
Kepchomo	0.10582	35.2203	Kapkorio	Tartar	Nandi	Swamp	Agriculture, Settlement
Tartar Spring	0.10745	35.24703	Kapkorio	Tartar	Nandi	Spring	Agriculture, Settlement
Lolmotio River	0.16167	35.22773	Chepkunyuk	Chepkunyuk	Nandi	Swamp	Farming, settlement
Lunyerere Wetland	0.10172	34.72115	Mukingi	Izava	Vihiga	Swamp	Water abstraction, Settlement
Mokoiywet Swamp	1.00805	34.89812	Kipyoywani	Kinyoro	Trans Nzoia	Swamp	Agrculture,setlement and grazing, Plantation
Muyuchi Spring	0.20862	34.76578	Shitochi	Khayega	Kakamega	Swamp	Farming,Settlement
Chepkoilel Swamp	0.58659	35.31477	Kuinet	Kiplombe	Uasin Gishu	Swamp	Settlement

Marura Wetland	0.58683	35.31493	Kuinet	Kiplombe	Uasin Gishu	Swamp	Agriculture Settlement
Matunda Spring	0.82289	35.12518	Matunda	Moi's Bridge	Uasin Gishu	Swamp	Agriculture, Settlement
Ziwa Dam	0.84037	35.25883	Sirikwa	Sirikwa	Uasin Gishu	Dam/Swamp	Farming
Maji Mazuri Swamp	0.87035	35.20852	Ziwa	Ziwa	Uasin Gishu	Dam/Swamp	grazing,watering cattles,fishing
Nzoia River	0.68525	34.88818	Kibisi	Mbakalo	Bungoma	Treatment Ponds	Sewage ponds, Indigenous Forest
Kewa Swamp	0.82835	35.0179	Ndalu	Ndalu	Bungoma	Swamp	Agriculture, grazing
Ligega Swamp	0.22188	34.25649	Ligala	N.East Ugenya	Siaya	Swamp	Grazing, Brick making,Agriculture
Majengo Swamp	0.05562	34.7217	Chango	Central Maragoli	Vihiga	Swamp	growing tea,bananas,settlement
Pan Paper Treatment Ponds	0.58606	34.79405	Township	Webuye	Bungoma	Treatment Ponds	Agriculture, Settlement
Dunga Swamp	-0.14356	34.73933	Nyalenda 'B'	West Kolwa	Kisumu	Swamp	Ecotourism,settlement, ecotourism
Hippo Point Swamp	-0.12388	34.74507	Nyalenda 'B'	West Kolwa	Kisumu	Swamp	Settlement, Ecotourism
Kitale Nature Conservancy					Kitale	Swamp	Ecotourism,Farming, grazing
Mokoiwet Swamp					Kitale	Swamp	Agrculture,Plantation,Settlement,Grazing

CHAPTER THREE: LITERATURE REVIEW AND SITUATIONAL ANALYSIS

3.1 Introduction

Extensive literature review and analysis was carried out to provide information on wetlands in the study area. Information gathered included trends in size, settlement patterns, resource use and governance practices and patterns. Relevant scientific articles and reports reflecting research on wetlands within the larger transboundary Mt Elgon and Cherengany hills were identified from the "Google Scholar" database among other sources. For purposes of quality control, only peer reviewed articles, official grey literature such as World Bank and government reports, constitution of Kenya, Acts of Parliament, World Conservation Union (IUCN, books, thesis and article abstracts are considered for analysis. All documents were published in the English language and no formal restriction was put on the time of publication.

Documents reviewed through this process include:

- Policy documents governing wetlands their uses and conservation
- Organizations, tasks, responsibilities and activities of the various actors and stakeholders with regard to the wetlands;
- Relevant legislation and regulations on national, regional and international level;
- Policies and strategies on environment among others.
- Scientific publications on wetlands, uses, conservation, threats etc
- Relevant Kenya Government publications

3.2 Study Rationale

Over the last century, wetlands continue to decline globally, both in area and in quality (Barbier et al 1993, Gardner et al 2015). In kenya, these declines have been attributed to anthropogenic activites such as pollution from agricultural land and over exploitation of wetland resources through overfishing, deforestation and catchment destruction, and water abstraction (Macharia et al 2007). The disappearance of wetlands will result to loss of

ecosystem services that sustain livelihoods in these areas. There are only a few published quantitative studies that deals with wetlands loss on an organized scientific basis. Although, the significance of wetlands has been documented country wide, the geographical work on the benefits and values of wetlands in Mt. Elgon and Cherenganya Hills, however, remain scatterd in various forms of literature. The current review will fill the information gap in this direction by mobiling all available information.

Objective of the literature review

To review existing scientific literature and reports on wetlands and springs in the study area with a view to providing an informed overview of the local, regional and national setting.

Research Articles

Through this review a total of thirteen (13) studies have been identified.. The finding indicates that six (6) research studies have been conducted on Sosiani River and four (4) studies conducted in Nzoia River. Two recent reviews have been conducted on national policies relevant to climate change adaptations around Mt. Elgon water catchment. Table 1 below gives an overview of the articles accessed during this review.

Table 2: Preliminary list of all articles obtained during the literature review.

Results of the first search phase with keywords: *"wet-lands Mt Elgon", "wet-lands Cherengany", "wetlands Kenya", "Mt Elgon Water Tower'', and "lake Victoria northern catchment"*	Assigned Categories	Study Wetlands
Banana, A. Y., Byakagaba, P., Russell, A. J., Waiswa, D., & Bomuhangi, A. (2014). A review of Uganda's national policies relevant to climate change adaptation and mitigation: Insights from Mount Elgon (Vol. 157). CIFOR.	Policy, climate change	Mt. Elgon Water catchment, Uganda
Ongugo, P. O., Langat, D., Oeba, V. O., Kimondo, J. M., Owuor, B., Njuguna, J., ... & Russell, A. J. (2014). A review of Kenya's national policies relevant to climate change adaptation and mitigation: Insights from Mount Elgon (Vol. 155). CIFOR.	Policy, climate change	Mt. Elgon Water catchment, Kenya
Dulo, S. O., Odira, P. M. A., Nyadwa, M. O., & Okelloh, B. N. (2010). Integrated flood and drought management for sustainable development in the Nzoia River Basin. Nile Basin Water Science & Engineering Journal, 3(2), 39-51.	Flood/Flood Risks, Drought Management	Nzoia River Basin
World Resources Institute; Department of Resource Surveys and Remote Sensing, Ministry of Environment and Natural Resources, Kenya; Central Bureau of Statistics, Ministry of Planning and National Development, Kenya; and International Livestock Research Institute (2007). Nature's Benefits in Kenya, An Atlas of Ecosystems and Human Well-Being. Washington, DC and Nairobi: World Resources Institute	Ecosystem types, human well-being, wildlife density, livestock density, human population density, rainfall, river drainage and networks, water supply and demand, crop production, biodiversity, tourism	Kenya water Towers
Sakataka, W., & Namisiko, P. (2014). Livelihood activities that impact on sustainable wetland use in upper Nzoia river basin, Kenya. J. Econ. Sustain. Dev, 5 (20), 70-83.	Livelihood, habitat degradation	Upper Nzoia River Basin

Table 2 Cont'd

Korir, J C (2014). An Assessment of the Environmental Impacts on Land Use and Land Cover Changes and Strategies of Reducing the Adverse Impacts: A Case of Eldoret Municipality, Uasin Gishu District, Kenya. Journal of Environment and Earth Science, Vol.4, No.23, 96-103.	Urbanization, habitat degradation, pollution	Eldoret Town
Ontumbi George, Morara, Sang Catherine, Chebet (2017). The Dynamics of Land Use/Land Cover on River Catchments in Kenya: A Justification by Sosiani River Catchment. Res J. Chem. Environ. Sci. Vol 5 [1] February 2017: 59-62	Landuse/landcover change, hydrology, habitat degradation, mitigation	Sosiani River Catchment
Oruta J. N (2016). Is the Sosiani River healthy? Investigating the relationship between water quality indicators and macroinvertebrate assemblages in the Sosiani river. International Journal of Geography and Geology, 2306-9872	Human activities, macroinvertebrate diversity, water quality	Sosiani River
Ontumbi, G., Obando, J. A., & Ondieki, C. M. (2015). The influence of Agricultural Activities on the Water Quality of the River Sosiani in Uasin Gishu County, Kenya.	Human activity, water quality	Sosiani River
Mul, C., Raburu, P. O., & Herrmann, J. (2011). Macroinvertebrates community structure in Rivers Kipkaren and Sosiani, River Nzoia basin, Kenya. Journal of Ecology and the Natural Environment, 3(2), 39-46.	Physico-chemical parameters, Benthic Macroinvertebrate Diversity	Kipkaren River, Sosiani River, and Nzoia River basin
Chibole, O. K. (2013). Modeling River Sosiani's water quality to assess human impact on water resources at the catchment scale. Ecohydrology & Hydrobiology, 13(4), 241-245.	Human impact, hydrology, water quality	Sosiani River
Achieng, A. O., Raburu, P. O., Kipkorir, E. C., Ngodhe, S. O., Obiero, K. O., & Ani-Sabwa, J. (2017). Assessment of water quality using multivariate techniques in River Sosiani, Kenya. Environmental Monitoring and Assessment, 189(6), 280.	Water quality	Sosiani River
Joab, M. J., Khaemba, A., Mburu, N., & Ngaywa Moses, A. (2014). Effects of Increased Land Use Changes on Runoff and Sediment Yield in the Upper River Nzoia Catchment.	Land use changes, sediment yields	Upper River Nzoia Catchment

3.3 Policy Frameworks, Legislations and Agreements

Kenya is a signatory as well as a party to various international conventions, treaties and protocols relating to the wetlands management. The agreements are both regional and international and became legally binding on Kenya upon ratification thereof by the rightfully designated Kenyan Authority. The global policy context is defined by the processes around the Ramsar Convention and other relevant environmental conservation treaties and the Convention on Biological Diversity (CBD). The regional policy context on the other hand is defined by the Treaty establishing the East African Community and the Protocol on Environment and Natural Resource Management. The national level context is defined by the Constitution, the National Land Policy, and the National Environment Management and Coordination Act, and the other sectoral policies and laws. Currently, there are two important policies relating to the management of wetlands; 1) the Draft Wetlands Conservation and Management Policy 2013 and the Environment Management Policy 2013.

Ramsar Convention on Wetlands

Kenya ratified the Ramsar Convention in 1990 **on Wetlands on 5 October 1990. Kenya presently has 6 sites designated as Wetlands of International Importance, with a surface area of 265,449 hectares.** The Ramsar sites include Lake Nakuru, Lake Naivasha, Lake Baringo, Lake Bogoria, Lake Elementaita and Tana River Delta. The convention provides a framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. The Ramsar Convention (Ramsar 1971) is the intergovernmental treaty that specifically addresses sustainable management of wetlands. The convention lays a lot of emphasis on wetlands wise-use and promotes sustainable practices and management of wetlands. Parties to the Convention also commit to specific actions regarding formulation and implementation of national plans so as to promote conservation of listed wetlands and the wise use of wetlands in their territory; research and exchange of data and publications regarding wetlands and their flora and fauna; and training of personnel in wetlands research, management and stewardship. No wetlands in Mt Elgon and Cherengany Hills ecosystems have been enlisted in the Ramsar site.

The Convention on Biological Diversity (CBD)

Kenya being a signatory has enacted a law on Environmental Management and Co-ordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006 (L.N. No. 160 of 2006). The CBD acts as a framework to which this law is passed. At the national and local levels this law provides a legal framework in the conservation of the biological diversity that are supported by wetland ecosystems, the sustainable use of its components, and the fair and equitable sharing of benefits arising from the use of genetic resources. In addition, the African-Eurasian Migratory Waterbird Agreement (AEWA) is an intergovernmental treaty dedicated to the conservation of migratory waterbirds and their habitats across Africa, Europe, the Middle East, Central Asia, Greenland and the Canadian Archipelago. The agreement focuses on bird species that depend on wetlands for at least part of their lifecycle and cross international borders in their migration patterns. Kenya is a signatory to agreement that offers a good opportunity for the management and conservation of Wetland.

The United Nations Framework Convention on Climate Change (UNFCCC)

The United Nations Framework Convention on Climate Change (UNFCCC), 1992 requires parties to take climate change considerations their economic development agenda. It emphasizes on the need of for sustainable development with a view of minimizing adverse effects on the economy, public health and the quality of the environment. Wetlands play significant roles in moderating micro-climate, water storage systems holding and releasing water, especially during dry season, situations currently experienced by communities as a result of climate change and variability.

The East Africa Community Treaty

The regional context for wetlands conservation and management is defined by the EAC, the regional integration framework that groups Kenya together with Burundi, Rwanda, Tanzania and Uganda. The Treaty Establishing the EAC recognizes the importance of natural resources to the economic development of the region. Article 5 thereof links the achievement of economic development to “the promotion of sustainable utilization of the natural resources of the Partner States and the taking of measures that would effectively protect the natural

environment of the Partner States". Furthermore, Chapter 19 of the Treaty provides for cooperation in environment and natural resource management to realize objectives that include ensuring "sustainable utilization of natural resources like lakes, wetlands, forests and other aquatic and terrestrial ecosystems". The Community has developed a Protocol on Environment and Natural Resource Management to further strengthen cooperation. In this regard Article 14 of the Protocol deals with sustainable management and wise use of wetland resources, and commits the Partner States to develop, harmonize and adopt common policies, laws and strategies for the purpose. It seeks to supplement the Ramsar Convention by providing for development and adoption of common guidelines and criteria for the declaration of any wetland other than a Ramsar site as a protected wetland. Kenya has also been part of processes within the framework of the African Union (AU) that led to the adoption of the Framework and Guidelines on Land Policy that articulates principles to inform the development and implementation of land policies in Africa. The Framework and Guidelines underscore the need to conserve and manage natural resources and ecosystems including wetlands. National land policies are thus expected to provide frameworks for conserving and managing such ecosystems to create foundations for sector specific policies and strategies.

The Constitution of Kenya 2010

The Constitutional dispensation of Kenya (2010) is regarded as 'green' law, recognizing and giving prominence to environment as a critical and integral part in achieving sustainable development. Article 2 sub-article 6 states that '*any treaty or convention ratified by Kenya shall form part of the law of Kenya under the constitution*'. Article 42 of the Bill of Rights provides all Kenyans with the environmental right to a clean and healthy environment, again giving prominence to the environment, not as a State-given resource, but, rather, God-given. The supreme law therefore underscores the need for sustainable utilization, exploitation, management and conservation of the environment and natural resources as well as ensuring ecologically sustainable development and the protection of ecologically sensitive areas (ESAs) such as wetlands. Article 60 of the Constitution entrenches principles of land policy that shall henceforth inform the manner in which land is held, used and managed in Kenya, with a view to ensuring equity, efficiency, productivity and sustainability. Two of these

principles – sustainable and productive management of land resources, and sound conservation and protection of ecologically sensitive areas – are of particular relevance to the design of an appropriate framework for conservation and management of wetlands. Article 62 states that "all land in Kenya belongs to the people of Kenya collectively as a nation, as communities and as individuals." Water catchment and specially protected areas are vested in the national government to hold in trust for the people of Kenya. Article 69 of the Constitution imposes obligations on the State with regards to the environmental planning. The State shall, inter alia, ensure sustainable exploitation, utilization and management and conservation of the environment and natural resources, and ensure the equitable sharing of accruing benefits; encourage public participation in the management, protection and conservation of the environment; and eliminate processes and activities that are likely to endanger the environment. Individual citizens have a duty to cooperate with State organs and other persons to protect and conserve the environment and ensure ecologically sustainable development and use of natural resources. The Constitution provides the legal framework in which new laws are enacted and old laws are ammended. The policies and legislation that have direct and indirect bearing on wetlands in Kenya are presented in Table 2 below.

Table 3: A preliminary assessment of some of the policies, legislations, and conventions related to wetlands in Kenya

Policies and Legislations	Impact on Wetlands
County Governments Act, 2012 (No. 17 of 2012).	• Article 176 of the Constitution provides for the election, functioning, control of, tasks and powers, etc. of county governments • Among the functions of county governments is the implementation of specific national government policies on natural resources and environmental conservation, including soil and water conservation and forestry. • County governments have an important role to play in implementation of Wetlands Policy and Wetlands Management Plans.
Draft Wetland Conservation and Management Policy (2013)	• The policy aims to achieve sustainable management and conservation of Kenya's wetlands through community participation and developing strategic programmes aimed at restoring the ecological integrity of these fragile and vulnerable resources • The policy ensures Kenya's commitment to the Ramsar convention, which it is party to and therefore provide the framework on wise use and sustainable management of wetlands. • The draft Policy seeks to: o Establish an effective and efficient institutional and legal framework for integrated management and wise use of wetlands which will provide an enabling environment for the participation of all stakeholders. o Enhance and maintain functions and values derived from wetlands, protect biological diversity and improve essential processes and life support systems of wetlands. o Promote communication, education and public awareness among stakeholders to enhance their participation in wetland conservation. o Carry out demand driven research and monitoring on wetlands to improve scientific information and knowledge base. o Enhance capacity building within relevant institutions and for personnel involved in conservation and management of wetlands o Establish a national wetlands information management system and database including tools and packages to targeted groups. o Promote innovative planning and integrated management approaches towards wetlands conservation and management in Kenya. o Promote partnership and co-operation at regional and international levels for the management of trans-boundary wetlands and migratory species
Environment Management Policy (2013)	• The policy provides clear provisions for Wetlands (coastal and marine-based and freshwaters) as key ecosystems in the natural environment land/seascape and are recognized as critical natural capital.
Environmental Management and Co-ordination (Wetlands, River	• These regulations define wetlands as areas permanently or seasonally flooded by water where plants and animals have become

Policies and Legislations	Impact on Wetlands
Banks, Lake Shores and Sea Shore Management) Regulation, 2009	adapted and incorporates riparian and coastal zones. • Its main purpose is to ensure the conservation and sustainable use of wetlands. • The regulations identify the need for an EIA for any development that may cause harm to the wetland. The project will be located along the coastline, and within its riparian, thus the need to carry out the ESIA study presented in this report.
Water Act, 2016 (No. 43 of 2016)	This Act is an update of the Water Act, 2002 (Cap. 372). • It makes provision for the provision of clean and safe water in adequate quantities and to reasonable standards of sanitation for all citizens. • This Act provides for the regulation, management and development of water resources and water and sewerage services in line with the Constitution. • It establishes the Water Resources Authority ("Authority"), the National Water Harvesting and Storage Authority, the Water Services Regulatory Board, the Water Sector Trust Fund and the Water Tribunal
The Wildlife Conservation and Management Act 2013	• The Act provides the framework for protection, conservation and management of wildlife in Kenya. • It establishes the Kenya Wildlife Service (KWS) as a uniformed and disciplined force and vests it with oversight of conservation, management and utilization of all types of fauna (other than domestic animals) and flora. • Wetlands are often habitat for fauna and flora, and are given protection under this act.
The Environmental Management and Coordination (Amended) Act of 2015	• The amended act provides for the legal regime to regulate, manage, protect and conserve biological diversity resources and access to genetic resources, wetlands, forests, marine and freshwater resources. • The Act harmonizes the various requirements of the other existing laws and regulations to minimize any conflicts in enforcement of the various environmental laws and regulations as applied to the relevant sectors. • It is the master plan for the environment in Kenya and contains a National Environment Policy, Framework Environmental Legislation and Environmental Strategy.
Environmental Management and Coordination Act (EMCA) No. 8 of 1999	Main Sections of EMCA Relevant to the Sustainable Management of Wetland include; • Section 42- Conservation of Wetlands -This section guides on conservation of rivers, lakes and wetlands and requires any activity conducted within the wetland to be authorized by the Director General. • EMC (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations, 2006 -The regulation aims at increasing the coverage of protected areas and establishing new special status sites. The regulation also intends to revitalize Agriculture by 2014 through comprehensive development of the agricultural sector at all levels for the benefit of the population • EMC (Wetlands, River Banks, Lake Shores and Sea Shore

Policies and Legislations	Impact on Wetlands
	Management) Regulations, 2009 - The aim of this regulation is to ensure conservation and sustainable use of wetlands in Kenya whether occurring in private or public land. • Section 4 of the regulation outlines the objective of the regulation which includes providing guidelines for • the conservation and sustainable use of wetlands and their resources in Kenya; • Section 5 (1) of the regulation outlines the General Principles to be observed in the management of all wetlands in Kenya • •Section 5 (2) of the regulation states that the obligations of the Regulations should be implemented while taking into account the provisions of other statues under different ministries. • Section 11 of the regulation permits the use of wetlands for domestic use among other uses. • Section 13 lists activities that may require temporary permits for the use of wetland including emergency cases and research activities requiring use of wetlands. The temporary permits will be valid for three (3) months only as stated under section 13(2). • Part III of the regulation gives guidelines on management of river banks, lake shores and sea shore in Kenya. • Section 17 of the same part outlines the general principles to be observed in the management and conservation of river banks, lake shores and the seashore • Section 18 of the regulation provides conservation measures for wetlands. Part (c) of the same regulation promotes soil conservation measures along river banks, lake shores, and the seashore which includes the following measures: bunding, terracing, mulching, tree planting or agro forestry, grassing, soil engineering, compaction and placement of fills, zoning and planning; building of gabions, control of grazing, and recommending the promulgation of appropriate by-laws by the local authority.
The Fisheries Management and Development Act 2016	• The Act provides for the conservation, management and development of fisheries and other aquatic resources to enhance the livelihood of communities dependent on fishing and to establish the Kenya Fisheries Services; and for connected purposes.
Forest Conservation and Management Act, 2016 (No. 34 of 2016).	• This Act makes provision for the conservation and management of public, community and private forests and areas of forest land that require special protection, defines the rights in forests and prescribes rules for the use of forest land. • It also makes provision for community participation of forest lands by community forest association, the trade in forest products, the protection of indigenous forests and the protection of water resources.
Public Health Cap 242	• The Act provides measures that safeguard and promote public health. The measures considered by the Act include those on prevention of discharge of pollutants into watercourses; prevention of mosquitoes breeding sites, sanitation management among others.
The Agriculture Act Cap 318	• This Act promotes and maintain stable agricultural production in the country through conservation of the soil and its fertility and to stimulate the development of agricultural land in accordance with the accepted practices of good land management and good

Policies and Legislations	Impact on Wetlands
	husbandry
Physical Planning Act 1999	• The Act gives provision for the development of local physical development plans and, it also guides and coordinates development of infrastructure within the county, municipal and town councils. • The Act also guides on land use and development.
Land Act Cap 280	• The Act seeks to provide for the sustainable administration and management of land and land based resources. • Section 11 of the Act empowers the National Land Commission to take appropriate action to maintain public land that has endangered or endemic species of flora and fauna, critical habitats or protected areas and to identify ecologically sensitive areas that are within public lands and demarcate or take any other justified action on those areas and act to prevent environmental degradation and climate change subject to consulting with existing conservation institutions. • The Commission also make rules and regulations for the sustainable conservation of land based natural resources that include measures to protect critical ecosystems and habitats.
The National Land Policy 2009	• The Policy recommends responses that include adoption and implementation of Land Use Plans (LUPs). • It outlines principles to guide the protection of watersheds, lakes drainage basins and wetlands. These include: prohibition of settlement and agricultural activities in water catchment areas; identification, delineation and gazzettement of all water courses and wetlands in line with international Conventions; and integrated resource management based on ecosystem structure regardless of administrative or political boundaries. • The Government also commits to ensure that all land use practices conform to land use plans and principles of biodiversity protection, conservation and sustainable development. This comprehensive management plan adopted Ecosystem-Based management (EBM) approaches requiring broader and holistic management regimes across boundaries
Forests Act of 2005 (No. 7 of 2005)	• It establishes the Kenya Forest Service (KFS), the functions of which include, "managing forests on water catchment areas primarily for purposes of water and soil conservation, carbon sequestration and other environmental services"
Survey Regulations, 1994 (Cap. 299)	• The Regulations provide for the reservation of land in case of survey for purposes of alienation of government land in coastal areas and near to lakes or tidal rivers.
Water Resources Management Rules, 2007 (L.N. No. 171 of 2007)	• The rules include: public notification and consultation; the protection of the water resources monitoring network; Water Resource Users Associations; the register of water bodies; approvals, authorizations and permits; declaration of a watercourse or a wetland for the purposes of water resources management by the Water Resource
Water Resources Management (Amendment) Rules, 2011 (L.N. No. 93 of 2011)	• These Rules amend the Water Resources Management Rules in rule 12 in relation with the identification of water resources inspectors and in rule 13 and the Twelfth Schedule in relation with the form of the Water Resources Management Authority regional incidence

Policies and Legislations	Impact on Wetlands
	occurrence register to be maintained by every region as part of the regional database.
Water Resources Management (Amendment) Rules, 2012 (L.N. No. 105 of 2012)	• These Rules amend the Water Resources Management Rules in the First Schedule, which specifies water charges, and in the Twelfth Schedule in relation with the form for a permit to discharge effluent waste water
Environmental Management and Coordination (Water Quality) Regulations 2006	• This regulation prohibits pollution of water bodies and encourages the engagement of the community in protection of water bodies both surface and underground. • The regulation provide guidance on several wetland management practices including: o Restriction of water abstraction without conducting an Environmental Impact Assessment o Observation of wetlands riparian zone of between 6-30m form the highest flood water mark of a water body o Compliance with the water quality for irrigation and domestic use as stated under the first and eighth schedule of the regulation respectively. o Provision of monitoring parameters for water bodies as listed under schedule two of the regulation
Kenya's Vision 2030	• The Vision 2030 which is a 20-year development blueprint recognizes wetlands and water catchments as key components in spurring economic growth, thereby reducing poverty. The social pillar of vision, recognizes that Kenya's journey towards prosperity involves the building of a just and cohesive society, enjoying equitable social development in a clean and secure environment. This sets the stage for ecosystems approaches to environmental management. Special emphasis is given on water catchment management and land cover and land use mapping. Management of catchment and water-based tourism provides entry points into sustainable of water and wetlands in the country

3.4 Relevant institutional arrangement for wetland management in Kenya

Institutionally, wetlands in Kenya are managed by diverse institutions such as National Environment Management Authority (NEMA), Water Resource Management Authority (WRMA), Kenya Wildlife Service (KWS), Kenya Forest Service (KFS), among others. More often than not, this poses a serious challenge of roles, overlapping mandates and responsibilities.

The National Environment Management Authority (NEMA)

In Kenya, wetland management is supervised under the National Environment Management Authority (NEMA) deriving this mandate from the environmental law (EMCA, 199), section 42. NEMA is the government authority charged with the general supervision and coordination of the environment matters in Kenya. The functions of NEMA with regards to wetland management is to promote the integration of environmental considerations into development policies, plans, programmes and projects, with a view to ensuring the proper management and rational utilization of environmental resources, on sustainable yield basis, for the improvement of the quality of human life in Kenya, to take stock of the natural resources in Kenya and their utilization and conservation and to examine land use patterns to determine their impact on the quality and quantity of natural resources.

Kenya Wildlife Service

A National Wetland Programme is also implemented under the Kenya Wildlife Services (KWS). KWS is the Ramsar administrative focal point, charged with the management of Kenya's Ramsar sites. KWS does not have authority over wetlands in unprotected areas, which constitute the biggest portion of the country's wetlands.

County Governments

The main objective of the County Governments to facilitate coordinated development and improve service delivery that would stimulate economic activity and high quality of life to its residents who reside in its area of jurisdiction. County government has the responsibility therefore, of ensuring a clean and healthy environment throughout their county.

Water Resource Management Authority

The Water Resource Management Authority (WRMA) is a state corporation under the Ministry of Water and Irrigation established under the Water Act 2002 and charged with being the lead agency in water resources management. In order for WRMA to undertake its stipulated responsibilities, the Act provides for decentralized and stakeholder involvement.

This is implemented through regional offices of the Authority based on drainage basins (catchment areas) assisted by Catchment Area Advisory Committees (CAACs). At the grassroots level, stakeholder engagements occur through Water Resource User Associations (WRUAs). The main objective of WRMA objective is to manage and protect water catchments.

The information generated so far reveal that extensive research work has been carried out in the study area and subsequently there is massive information regarding the area in general. However, there are only a few published quantitative studies that deal with wetlands loss on an organized scientific basis. Although, the significance of wetlands has been documented country wide, the geographical work on the benefits and values of wetlands in Mt. Elgon and Cherengany Hills, remain scattered in various forms of literature. The literature reviewed in thisnsturdy has made an attempt to consolidate the currently available literature and legislation that would specifically be relevant for the study areas

Kenya does not have a national policy on wetlands at the moment. However, there is a draft Wetlands Policy (National Wetlands Conservation and Management; Draft Policy 2013) which aims to enhance the conservation and wise use of wetlands as well as promote recognition of wetlands as an integral component of the environment. The Policy seeks to strengthen the contribution of wetlands to sustainable development and the improvement of the livelihoods of the Kenyan people at the local and national level. The objectives of the Wetlands Policy are to:

I. Establish an effective and efficient institutional and legal framework for integrated management and wise use of wetlands which will provide an enabling environment for the participation of all stakeholders
II. Enhance and maintain functions and values derived from wetlands in order to protect biological diversity and improve livelihood of Kenyans
III. Promote communication, education and public awareness among stakeholders to enhance their appreciation and participation in wetland conservation
IV. Carry out demand-driven research on and monitor wetlands to improve scientific information and knowledge base

V. Enhance capacity building within relevant institutions and for personnel involved in conservation and management of wetlands

VI. Establish a national wetlands information management system and database including tools and packages to targeted groups

VII. Promote innovative planning and integrated management approaches towards wetlands conservation and management in Kenya

VIII. Promote partnership and cooperation at regional and international levels for the management of trans boundary wetlands and migratory species.

IX. The improvement and promotion of water storage infrastructures like dams, pans, household roof-catchments, and road runoff harvesting, in appreciation of the fact that capturing and storing rainwater is instrumental in the attainment of water security across seasons and years

The Policy identifies the challenges facing wetlands in Kenyan and proposes measures to address those challenges including establishing wetland conservation areas, restoring and rehabilitating degraded wetlands, education and public awareness, and recognizing, protecting and promoting the user rights of communities living adjacent to wetland resources. Despite the importance of conserving wetlands as water catchment areas, this Policy is yet to be adopted

The Agriculture Act (Cap 318) of 1986 (revised) gives the Ministry of Agriculture the mandate to ensure the adoption of sustainable agricultural practices in order to protect and conserve the country's environment.

The key activities identified to promote better land-use practices include:

I. Laying of terraces on small-scale farms with more than 12.5% slope

II. Promotion of rainwater harvesting and surface runoff management technologies to help farmers and local communities for domestic and food production to reduce water abstraction from wetlands.

III. Riverbank protection for communities living along riverbanks. Local communities need to be sensitized on the need to demarcate areas to be left under natural vegetation to support biodiversity as well as protect from storm events and flooding.

Buffer zones provide gradients between totally-protected land and intensively used land.

IV. Construction of water pans and small earth dams used for agroforestry nurseries, tree planting, food crop production, and watering livestock so as to avoid direct harvesting of water from wetlands; each water pan needs to have a sub-catchment area that is protected and conserved, contributing further to the overall conservation of natural resources.

V. Enforcement of the 10% farm forestry rule – gazetted by the Ministry in 2009 – requiring that a minimum cover of at least 10% of each farm holding be planted with trees or woodlot

VI. Develop and promote Hillside terracing

VII. Develop and promote Carbon credit trading and carbon offset programmes

VIII. Develop and promote point and non point Pollution control measures

IX. Enforcement of relevant provisions in the water Act, EMCA to prevent wetland encroachment Enforcement of bylaws to prevent storm water damage, e.g. soil erosion, to bare land within counties

X. Map out erosion hotspots and use of vertiva grass on road sides and other difficult erosion hotspots

XI. Constructing inter-basin and intra-basin water transfers to channel water from areas with excess water to areas with water scarcity

XII. De-silting rivers and dams to improve carrying capacity, water storage and water quality

CHAPTER FOUR: WETLANDS BIODIVERSITY

4.1 Introduction

Wetlands are biologically significant since they support a robust faunal and floral community. However, if negatively impacted, most of the otherwise abundant aquatic life would not survive. This makes biodiversity an important parameter in the assessment of the integrity of such vulnerable habitats. However, biodiversity *per se* is presently given a minor consideration in environmental policy. It has been regarded as too broad and vague a concept to be applied to real-world regulatory and management problems (Noss, 1990). One of the best ways that has been used to overcome this challenge is the use of selected measurable indicators to assess the status of biodiversity over time. For the field assessment, current study settled on the use of birds and herpetofauna as the biodiversity indicators of choice. Biological significance of the wetlands was therefore assessed based on species diversity and richness as pegged on the two taxa.

Water birds have attracted the most attention of all the wetland biota, and protection of their wetland habitat was one of the primary focus areas for the Ramsar Convention on Wetlands in 1971. As indicators, birds may detect aspects of wetland landscape condition that are not detected by other indicator groups particularly the connectivity between wetlands at large spatial scales. Many nationally and internationally important wetland sites have been listed on the basis of the bird species occurring there (Butcher 2003) e.g in Kenya Most of the Rift-valley lakes e.g. Nakuru, Elementaitata, Bogoria, Naivasha are important under the Ramsar Convention. For this reason, birds are sometimes valued as surrogates, or indicators of wetland condition. Nutrient enrichment of water alters the vegetation structure and the availability of prey, indirectly affecting wetland bird communities. Excessive nutrients, on the other hand, cause algal blooms which can kill fish, impact on macrophytes by blocking light, and affect bird foraging by reducing the visibility of prey taxa located in the water column (Adamus et al. 2001).

4.2. Birds Survey

Methodology

A Rapid bird assessment was conducted as part of wetland mapping. The survey was aimed at establishing bird species utilizing the various wetlands within the Mount Elgon and Cherengany Hills forest ecosystem**.**

A combination of quantitative and qualitative methods was used to characterize bird assemblages. All birds heard or seen were recorded. The importance of the wetland habitat for bird species was assessed by noting their importance for foraging, nesting, migration and roosting. The importance was recorded with presence or absence of species.

In addition to species survey, habitat assessment was determined to establish the status of the different wetlands. The variables that were used to determine their status and suitability for bird included surrounding land use, threats to wetlands, management and ownership of land.

Given the nature of the rapid assessment approach, we identified specific areas in which to assess birds and their habitats based on the selected sites as determined through satellite images described in chapter two above.

4.2.1 Analytical Outlook of Birds in the Ecosystem

Birds are sensitive indicators of biological richness and environmental trends and fulfill many key ecological functions; they contribute to our understanding of natural processes; they are an important economic resource; and they have inspired and delighted people of many cultures for centuries, which makes them excellent ambassadors for the promotion of conservation awareness and international collaboration. It is important to recognize that the problems affecting birds, their habitats and our global environment are linked inseparably with social, economic and cultural factors and that these can only be resolved if human societies function in an ecologically sustainable manner and if the needs, welfare and aspirations of people form a part of all conservation action.

Past research (Bennun and Njoroge 1999, Birdlife International 2017) has revealed that both ecosystems are rich in montane avifauna and this has also been confirmed by our recent

survey. More than 400 bird species have been recorded within the two ecosystems (see Appendix 1). Overlaps were also noted within the two ecosystems. However Mt. Elgon is more diverse perhaps due to its trans boundary nature and level of protection it enjoys from the fact that part of the ecosystem gazetted as a National park. The avifauna of the Cherengany is characteristic of the highland forests of Kenya west of the Rift Valley, comprising both central highland species and western species. Ecological surveys have recorded over 73 forest-dependent species. Regionally threatened species include *Gypaetus, Stephanoaetus coronatus, Glaucidium tephronotum, Campephaga* and *Indicator conirostris*. The wooded grasslands on the north-eastern side of Mount Elgon hold a number of unusual birds, including the Sudan–Guinea Savanna biome species that all have very restricted ranges in Kenya. Nineteen of Kenya's 43 Guinea–Congo Forests biome species have been recorded, although as many as 10 of these may now be extinct.

Besides the Montane rich forest species, the two ecosystems have a high diversity of unique wetland bird species (see table 3) and other wetland biodiversity contributed by the presence of wetland habitats with varying biophysical characteristics. They could simply be described as: pasturelands associated with riverine wetlands, islands in the middle of small dams, grass-covered fringes of papyrus-dominated floodplains and grassed dam edges bordered by riverine forests.

Among the wetland species, the Grey crowned crane was noted as the most common and highly encountered both on the wetlands (both natural and man-made) and in farmlands adjacent to wetlands. The species uses the farmlands for foraging and different types of wetland for breeding or roosting. The species was also very common among the locals and they commonly referred to as ''*Ng'oli*'' in Transnzoia county. The behavior and distribution of the species within the ecosystem makes it suitable candidate for inclusion in future monitoring programmes as a good indicator for wetland degradation. This is because the principal threat to grey crowned-crane populations is the degradation of suitable wetland habitat, due to an increasing human population accelerating the demand for agricultural land and freshwater sources. Increasing human populations in the ecosystem also threaten grey crowned-crane habitat via wetland damming, drainage, increased sedimentation through deforestation and the use of agricultural pesticides.

Plate 2: Wetland Birds (White Faced Whistling Ducks), Kobura Irrigation Scheme

Table 4 below provides an overview of some key wetland birds in the study area while Appendix 1 is a complete record of bird species in Mt. Elgon and Cherengany Hills Forest Ecosystem

Table 4. Some key wetland birds in Mount Elgon and Cherengany Hills Ecosystem

Common/English Name	Scientific Name	Habitats
Long-tailed Cormorant	*Phalacrocorax africanus*	Emergent
African darter	*Anhinga rufa*	Emergent
Grey heron	*Ardea cinerea*	Grass
Purple Heron	*Ardea purpurea*	Emergent
Squacco Heron	*Ardea ralloides*	Emergent
Cattle Egret	*Bubulcus ibis*	Emergent
Great White Egret	*Egretta alba*	Emergent
Little egret	*Egretta garzetta*	Emergent
Night heron	*Nycticorax nycticorax*	Emergent
Hamerkop	*Scopus umbretta*	Emergent
Yellow billed stork	*Mycteria ibis*	Grass
Yellow billed duck	*Anas undulata*	Emergent
Hadada Ibis	*Bostrychia hagedash*	Grass
Glossy Ibis	*Plegadis falcinellus*	Grass
Sacred ibis	*Threskiornis aethiopica*	Grass
African Spoonbill	*Platalea alba*	Emergent
Fulvous Whistling Duck	*Dendrocygna bicolor*	Emergent
Hottentot Teal	*Anas hottentota*	Emergent
Maccoa Duck	*Oxyura maccoa*	Grass
Spur-winged Goose	*Plectopterus gambensis*	Grass
Eurasian Marsh Harrier	*Circus aeruginosus*	Grass
African Marsh Harrier	*Circus ranivorus*	Emergent
Grey Crowned Crane	*Balearica regulorum*	Emergent
Lesser Moorhen	*Gallinula angulata*	Emergent
Black Crake	*Limnocorax flavirostra*	Grass
Purple Gallinule	*Porphyrio porphyrio*	Grass
African Water Rail	*Rallus caerulescens*	Grass
Red knobbed Coot	*Fulica cristata*	Grass
African Jacana	*Actophilornis africanus*	Grass
Ringed Plover	*Charadrius hiaticula*	Grass
Long-toed Plover	*Venellus crassirostris*	Grass
Black-winged Plover	*Vanellus melanopterus*	Grass
Wattled plover	*Vanellus senegallus*	Grass
African Snipe	*Gallinago nigripennis*	Grass
Black-tailed Godwit	*Limosa limosa*	Grass
Ruff	*Philomachus pugnax*	Grass
Black Winged Stilt	*Himantopus himantopus*	Emergent
White-winged Black Rern	*Chlidonias leucopterus*	Emergent
Pied Kingfisher	*Ceryle rudis*	Emergent
Malachite Kingfisher	*Alcedo cristata*	Emergent
Woodland Kingfisher	*Halcyon senegalensis*	Woodland
Stonechat	*Saxicola torquata*	Emergent
White-winged Widowbird	*Euplectes albonotatus*	Emergent
Fan-tailed Widowbird	*Euplectes axillaris*	Emergent

Common/English Name	Scientific Name	Habitats
Golden Palm Weaver	*Ploceus bojeri*	Emergent
Holub's Golden Weaver	*Ploceus xanthops*	Emergent
Great white eagle	*Egretta alba*	Emergent
Black headed heron	*Ardea melanocephala*	Emergent
Crowned crane	*Balearica regulorum*	Emergent
Spur winged plover	*Vanellus spinosus*	Emergent

4.3 Herpetofauna

Reptiles and Amphibians in Mt Elgon and Cherengany ecosystems

Amphibians and some reptiles such as crocodiles are known to breed and lay eggs in/or near aquatic habitats during short breeding seasons lasting days or weeks and migrate to marginal habitats for the rest of the year to forage and aestivate (e.g. Spawls et al., 2002; Channing and Howell, 2006). Amphibians attempting to use the wetlands for breeding and life cycle completion (from egg to adult) may be vulnerable to adverse effects of process-treated waters on which the wetlands are based. Such species can be used as surrogate measures as habitat quality or bio-indicators. If such organisms could not survive, it is likely that other aquatic organisms indigenous to the region and having at least part of their life cycle dependent on an aquatic stage would also be at risk.

Plate 3. Achieta's rodged frog (Kitale Nature Conservancy)

Many studies have shown the close dependence of some semi-aquatic species (e.g. amphibians and reptiles) on riparian habitats for critical life-history functions. There is substantial evidence that terrestrial habitats surrounding wetlands are important for the management of water and wildlife resources. These habitats have also been shown to serve as sites of physical and chemical filtration processes that protect water resources from negative impacts like siltation and chemical pollution (Davies and Nelson, 1994). Therefore, amphibians are widely recognized as useful indicators of ecosystem health (Sheridan and Olson 2003). Aspects of their life history and ecology make them particularly vulnerable to perturbations of natural systems (Collins and Storfer 2003). Some of the indices that are most useful in this approach are estimates of abundance and diversity of target species.

4.3.1 Field Sampling Protocol for Herpetofauna

During the rapid assessment, we employed a habitat-based, stratified sampling design to assess the biological richness of selected wetlands by comparing amphibian and reptile

densities across the study area. At each wetland, a visual encounter survey (VES) was employed as described by Heyer et al. (1994). All the different target species found were observed, identified and recorded. All microhabitats including above ground, below ground, and aerial vegetation were searched. Where possible, these observations were supplemented by indigenous knowledge obtained from local residents with special reference to some charismatic species such as terrapins and monitor lizards.

The species list for the herpetofauna documented from the study area (from both field survey and literature) are as captured in **Annex 2**

4.3.2 Threats and Interventions

Mt Elgon and Cherengany Hills ecosystems are endowed with unique habitats and biodiversity of local, national and global significance (e.g. Chaning & Howell, 2006; NMK & Makere University, 2004). Wetlands are some of the habitats that maintain a high diversity of fauna such as reptiles and amphibians (see Annex 1). According to Njuguna (2004), existing rural activities and poor land management practices have affected this biological resource in two ways: 1) by fueling the demand for more agricultural land and therefore altering natural habitats; and 2) by altering the chemical properties and therefore reducing soil and plant diversity. As a result, global (as well as local) declines and/or extinctions have been reported (see Ficetola et al, 2015; Gower et al 2013; Beebee & Griffiths, 2005; Stuart et al 2004; Collins & Storfer, 2003). Habitat changes and losses are known to have impacted amphibians for decades (Collins and Storfer, 2003). In this regard, wetlands are among the most highly affected amphibian habitats.

Interventions

Many species found in Mt Elgon and Cherengany Hills ecosystems are listed as threatened under IUCN Red List criteria (IUCN, 2017). For instance, the torrent Frog *Arthroleptides dutoiti* is a critically endangered frog known from Mt Elgon but has not been observed or collected for over 50 years. There has been a recent surge of interest in finding this frog, prioritized for conservation attention by ZSL's EDGE of Existence Programme (Isaac et al.

2012). A minority of small wetlands are currently included within the national conservation area networks e.g. parks, reserves and private conservancies within the two ecosystems.

4.4 Vegetation

The general status of wetland vegetation within Mt. Elgon and Cherengany catchments show more than 70% degradation. We assessed the current status and quality of flora in selected wetlands within Mt. Elgon and Cherengany regions using a rapid appraisal methodology. This entailed taking photos and recording the observed species occurrences and dominance vegetation in all the wetlands assessed within the two catchment areas. All wetland vegetation were disturbed either partially or completely. Previously used wetlands (abandoned croplands) were dominated by Cyperaceae whereas Poaceae and Asteraceae families dominated intensively cultivated wetlands. Conservative species e.g. *Cyperus papyrus* and *Cyperus exaltatus, Schoenoplectus corymbosus* ((Roth ex Roem. & Schult.)), *Cyperus dives* (Delile), were restricted to unused wetlands. Generalists such as *Commelina benghalensis, Cynodon dactylon, Cyperus rotundus and Galinsoga parviflora* were widespread in reclaimed/or completely drained wetlands that are now permanently under crops. More than 70% of the species recorded maintained a local geographical distribution but were not representative of the vegetation within small wetlands of either Mt. Elgon or Cherengany, an indication that widespread transformation of wetlands to agricultural fields was slowly changing vegetation composition from the original Cyperaceae dominated habitats to that dominated by opportunistic and cosmopolitan annual species. Examples of counties within the two catchment areas where wetlands are first disappearing included Kitale area, Busia County, Siaya, Kakamega, Nandi, Uasin Gishu among the counties assessed.

The wetlands degradation can be attributed to the prevailing drivers and pressures e.g. population pressure, demand for land including wetlands goods and services such as raw materials (e.g. *Cyperus papyrus*). Brick making was also a serious economic activity observed that is fast degrading the wetland resources.

Information on the Water Catchment Ecosystems that feed the wetlands unders study are presented in Table 4.

Table 5: Key tree species for various water Catchments in Mt Elgon-Cherengany Ecosystem

Cherengany Hills	BAMBOO Woodlands	2,100 - 3,300	*Yushania alpina, Afrocrania volkensii, Podocarpus latifolius, Hagenia abyssinica, Rapanea melanophloeos, Dombeya torrida, Dracaena afromontana, Nuxia congesta.*
	Moist montane forest (lower parts of Kiptaberr-Kapkanyar)	1,800 - 2,450	*Pouteria adolfi-friederici, Albizia gummifera, Prunus africana, Casaeria battiscombei, Syzygium guineense, Polyscias fulva, Dombeya torrida*
	Dry montane forest (S. and E. slopes	1,800 - 2,900	*Juniperus procera, Olea europaea ssp. cuspidata, Podocarpus falcatus, Nuxia congest, Cassipourea malosana, Apodytes dimidiata, Ekebergia capensis, Olinia rochetiana, Teclea nobilis, Ephorbia spp.*
Kakamega forest	Tropical rain forest	1,550 - 1,650	*Pouteria altissima, Croton megalocarpus, Antiaris toxicaria, Zanthoxylum gillettii, Celtis gomphophylla, Prunus africana, Maesopsis eminii, Albizia grandibracteata, Milicia excelsa, Polyscias fulva, Funtumia africana.*
Nandi Forest	Tropical rain forest	1,700 - 1,850	*Pouteria altissima, Croton megalocarpus, Antiaris toxicaria, Zanthoxylum gillettii, Celtis gomphophylla, Prunus africana, Maesopsis eminii, Albizia grandibracteata, Milicia excelsa, Polyscias fulva, Funtumia africana.*
Elgeyo marakwet escarpment	Escarpment dry forest	1,900 - 3,000	*Warburgia ugandensis, Olinia rochetiana, Sapium ellipticum, Prunus africana, Olea europaea ssp. cuspidata, Juniperusprocera, Podocarpus falcatus, P. latifolius, Nuxia congesta, Ekebergia capensis, Teclea nobilis, Acokanthera schimperi, Zanthoxylum usambarense.*

Source: MEMR (2012). Masterplan for the Conservation and Sustainable Management of Water Catchment Areas in Kenya

Saiwa Swamp occurring within the catchment of Mt. Elgon Catchment, is a protected wetland in the park which had been visited during an earlier survey. The swamp had a vegetation consisting of large stands of bulrush (*Typha domingensis*), reeds (*Cyperus latifolia*). The general vegetation around the swamp is critical for buffering the swamp thus protecting it. The table below shows the richness of such protected area thus emphasizing the need for protecting these wetlands at catchment levels.

Saiwa Swamp occurring within the catchment of Mt. Elgon Catchment, is a protected wetland in the park which had been visited during an earlier survey. The swamp had a vegetation consisting of large stands of bulrush (*Typha domingensis*), reeds (*Cyperus latifolia*). The general vegetation around the swamp is critical for buffering the swamp thus protecting it. The table below shows the richness of such protected area thus emphasizing the need for protecting these wetlands at catchment levels.

Plant Species in Saiwa National Park

Previous studies have listed the following species as occuring around Saiwa National Park: *Prunus africana, Maesa lanceolate, Acacia hockii, Maytenus heterophylla, peripolca liuearfolia, Eriosema turioniarum, Helichysum panduratum, Spermacole prissila, Kalanchoe densiflora, Rhus natalensis, Melinus minutiflora, Leonatis spp., Berkeya spekeana, Setaria fasilata, Toddalia asiatica, Hippocratea spp.* Adopted from (Akwee et al., 2010).

Cherengany

Of the catchment areas in Kenya, it is arguably the most heavily impacted by human activity and agriculture, since it occurs in Trans-Nzoia County, which is part of the country's 'bread basket' or the most productive maize-growing area. The destruction was largely driven by the politically based forest excisions that occurred in Kenya during the 1980s and 1990s. The actual forest cover is diminished to a level where it is not listed as a forest area in the current KFS strategic plan other than the Embobut area. The Cherengany Hills still functions as a catchment, drawing relief rainfall, but the poor condition of the forest is evident in the silt

load carried by the Nzoia and Birbiriet rivers. Increasing density of settlements and intensification of land-use activities driven by rapid population growth and increasing poverty continue to exert pressure on the Cherengany Hills forests.

4.5 Other notable taxa from literature

Apart from avifauna the wetlands are also acts as a nursery and refuge for Lungfish (*Protopterus aethiopicus*) and Catfish (*Clarias mossambicus*). The Sitatunga antelope and other smaller antelopes, spring hares do also reside within the wetlands that were visited. Fish records in the ichthyology collection revealed that a total of 11 fish species have been documented from Mt.Elgon ecosystem. These are shown in Table 6.

Table 6. Wetland fish species

Scientific name	local name(Luhya)	Uses
Amphilius jacksonii	Esefu	Food
Clarias sp	Mkoe	Food
Babus sp	Pinji	Food
Pseudocranilabrus multicolor	Omena	Food
Clarias gariepinus	Mkoe	Food/Aquaculture
Oreochromis sp		Food/Aquaculture
Barbus cercops	obaduba/Pinji	Food
Barbus altianalis		Food
Barbus neumayeri		
Barbus percivali		
Oncorhynchus mykiss		

Source: Ichthyology section (2000). Fisheries Department(2003).

Macroinvertebrates; Virtually all representatives of wetland macroinvertebrates have been recorded in the wetlands, for instance, in Saiwa Swamp they include Ephemeroptera, Lepidotera larvae, Diptera (e.g. Chiroronomids, mosquito larvae, etc), Hemiptera (e.g. Corexidants), Annelida (e.g. tubifids and oligochaets) and Coleoptera. From Uasin-Gishu wetlands many macoinvertebrate species have been recorded: *Adonante anatica*, *Limnae auriculata*, Members of the family Tubificidae, *Plea spp*. *Leventra spp*., *Hygrocus spp*., *Brachioptera spp*., *Collubetes* spp., *Valvatta cristata, Cordulegaster spp*., *Philopotomus spp*.,

Gomphus spp., Micronecta spp., Naiaechna spp. , Notonecta spp., Glosiphonia spp. , Denectes spp.

Zooplankton; Zooplanton documented from the Uasin Gishu wetlands include *Eucypris sp, Lepidocaris sp, Chydorus, Cyclops sp, Brachionus rubens, Tetramatrix sp, Euchlanis sp, Ceriodaphnia, Conochilus, Macrolitrix sp, Keralella guandratta* , Cychlop sp , *Nothalca sp, Filina longiseta, Diaphanosoma sp, philodina sp, Hexarthra sp,Brachionus rubens,Chromogastersp,Gastropus sp, Keratella cochlearis,Chromogaster sp, platyias sp,Rotaria, Conochilus sp, Limnocalanus sp, Daphnia magna, Simocephalus sp,Lecane sp, Bosmina sp(* Njuguna 1996)

Higher plants; Saiwa National Park has over 480 plant species of which 37% is wetland vegetation. The dominant vegetation is the bulrush, *Typha dominensis.* Reeds, sedges e.g. *Cyperus latifolius*, and tall swamp grasses such as *Echnochloa pyramidalis* and *Pycreus lankecus* interspersed with extensive patches of low vegetation, mainly *Hygrophila spiciformis, Ranunculus multifidus, Beckeropsis uniset, Oenanthe palustris, Hydrocotyle ranunculoides* and *Polygonum setulosum*. In some parts of the swamp, *Plectranthus edulis*, a dicotyledonous forest herb has established itself as the dominant species. Shallow parts of the swamp are occupied by the upland sedges e.g. *Micanthus violaceus, Pycreus lanceus* and *Cyperus rigidifolia*. The swamp is bordered by remnants of tropical gallery forests composed of many trees and shrubs including *Ficus* sp., *Phyllanthus* sp., *Grewia* sp., *Pavonia* sp., *Albhizia* sp., *Termnalia* sp., *Syzigum*, and *Hibiscus* sp. Owen, (1970).

Lower plants (Phytoplankton); The following phytoplankton species have been observed in the these wetlands: *Scenedesmus spp., S. arcualus , Crucigenia tetrapedia, Euglena gracilis, Rhopaludia spp., Pleuvolium ovalum, Cosmarium glyptodermum, C. pachydermum, Meridion sp., Frustula sp., Oscilatoria sp., Chroococus sp., Diatomella sp., Tetraedron arthrodesmiforme, Ulothrix cylindricum. ceretinum hirundinella, Chlorella vulgaris sp, Dentricula sp, Meridio sp, Microcystis aeruginosa,Rhoicosphania curvata, Botryococcus sedeticus, Chlamydomonas polyperenoide, Oscillator tenuis (* Njuguna 1996)

Some wetland plants and their uses; Wetland plants in the region are a valuable source of food, fodder for animals, and others provide building and thatch materials, and fuelwood

(Table 3). Some wetland flora is utilized as medicinal plants. Twenty-six wetland plants have been found to be used as a source of food.

SECTION II

CHARACTERIZATION AND DEVELOPMENT OF MODELS FOR CONSERVATION AND REHABILITATION

CHAPTER FIVE: WETLAND CHARACTERISATION

5.1 Introduction

Description and categorization of wetlands resources requires three basic characteristics of wetlands, namely: a) permanence and seasonality of their moisture regime, b) the main vegetation and land cover types, c) resource pressure from human use (Tiner, 1999). This section therefore attempts to categorize Mt. Elgon and CherenganyCherenganyCherengany wetlands by the three characteristics. About 75% of Kenya's wetlands are ephemeral, majority of which are dominated by *poaceae* as a dominant vegetation. On other hand the permanent wetlands are in most cases dominated by cyperaceae. In western Kenya the dominant vegetation in most permanent wetlands is *Cyperus papyrus*. Papyrus wetlands occupy the transitional zone between permanently wet and generally dry environments (Morrison et al., 2012). The outcome of this this assessment indicate that wetlands in Mt. Elgon and Cherengany regions are dominated by permanent wetlands with cyperaceae as the dominant vegetation. However during the time of the survey a greater proportion of these wetlands appeared to be seasonal. This was probably attributed to the long dry spell (Scheffer et al., 2001) that has affected the eastern part of the Africa for the past six months. Theses wetlands provide various services to the local resents including tourism, water provision, harvesting of resources such as papyrus reeds, brick making among others. Most of the wetlands were faced with various pressures including encroachment for crop farming, grazing water abstraction and invasion by alien species.

5.2 Wetland types

5.2.1 Seasonality

The rapid wetland assessment outcome indicates that majority (85%) of wetlands within Mt. Elgon and Cherengany are permanent (Figure 5). Majority of these wetlands were dominated by either fresh water marshes or swamps (Figure 6). Other wetland types documented included riverine and manmade wetlands. Most counties surveyed contain many permanent wetlands. However Uasin Gishu and Kitale registered the largest number of permanent wetlands.

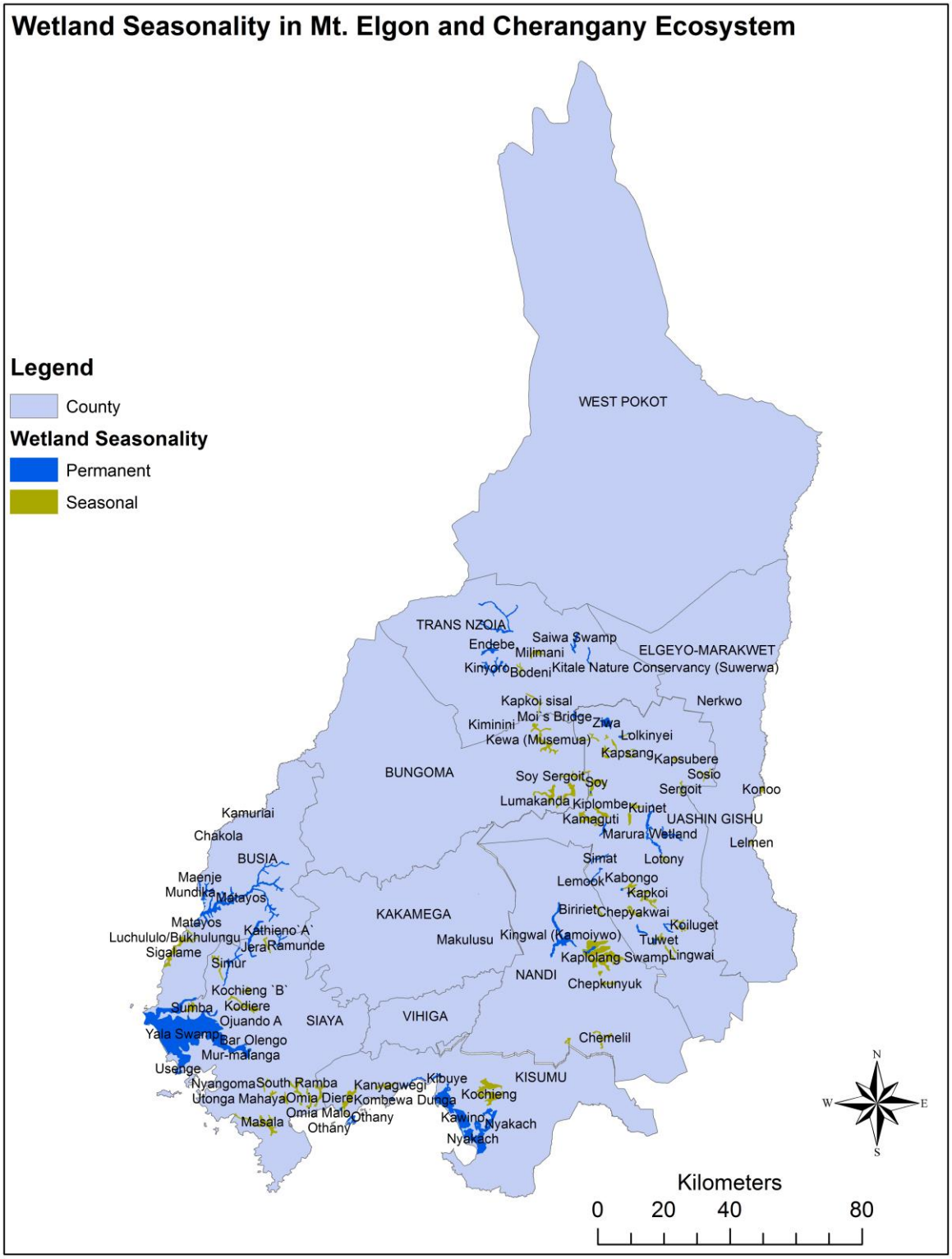


Figure 5: Wetland distribution and seasonality in Mt. Elgon and Cherangany Ecosystem

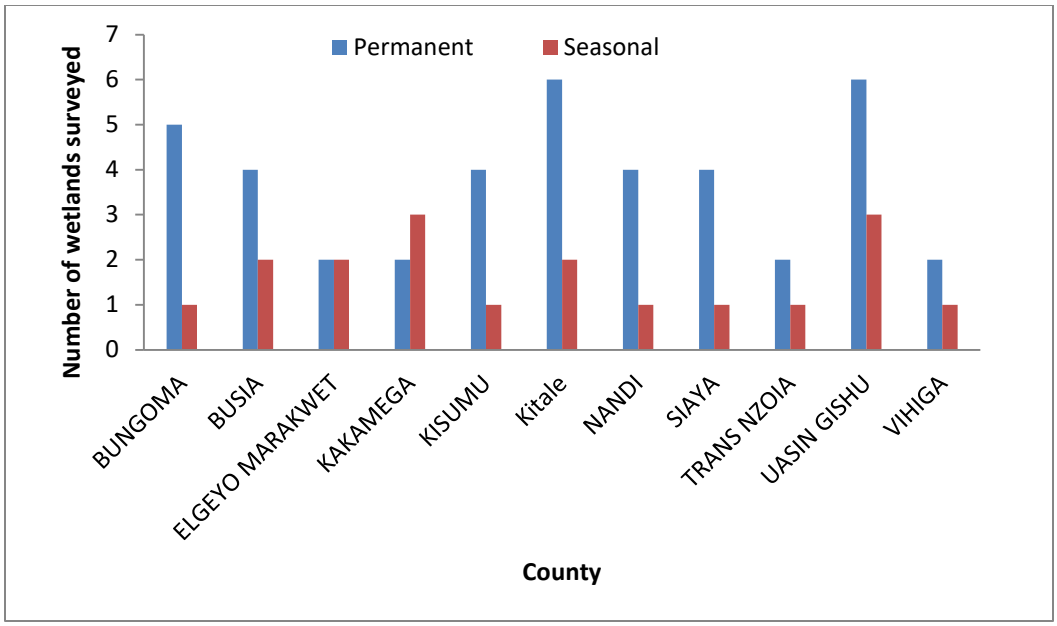


Figure 6: Seasonality of wetlands by county

Most of the wetlands in both Mt. Elgon and Cherengany are dominated by fresh water swamps (39%) and marshes (28%) (Figure 2).

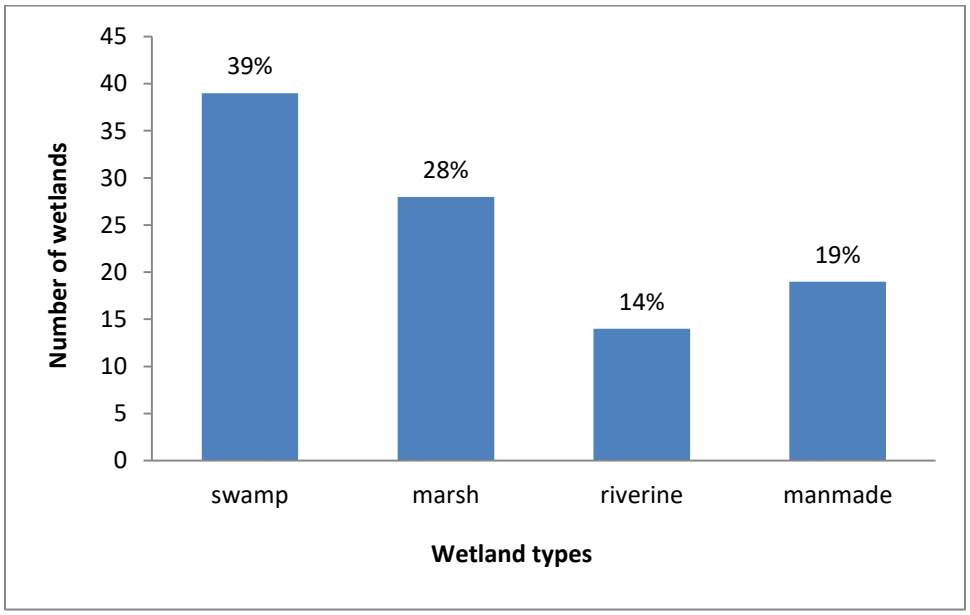


Figure 7: Proportion of wetland types surveyed in Mt. Elgon and Cherengany

At the county level the distribution of these wetlands also shows dominance by fresh water swamps and marshes (Figure 7).

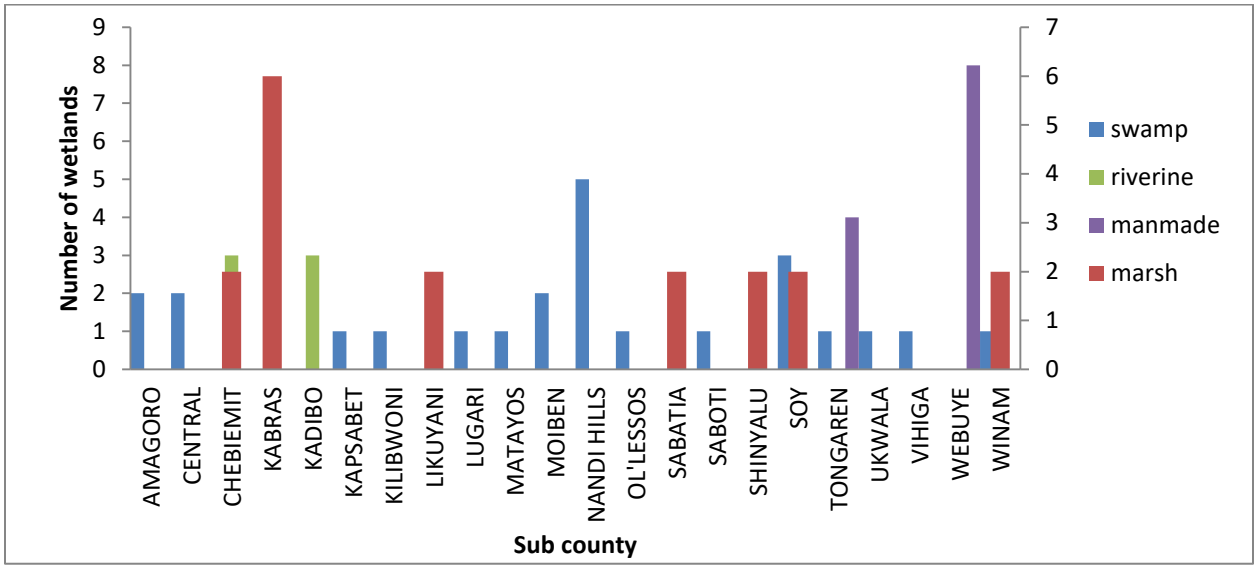


Figure 8: Wetland types by sub county

5.3 Dominant Vegetation

Of the wetlands surveyed, the dominant vegetation was of genus Cyperaceae (sedges) accounting for 40% of the wetlands surveyed and Poaceae (grasses) on wetlands that were less disturbed. On the other hand Typha sp and food crops dominated wetlands that were either manmade or those completely drained and transformed into agricultural land (Table 1).

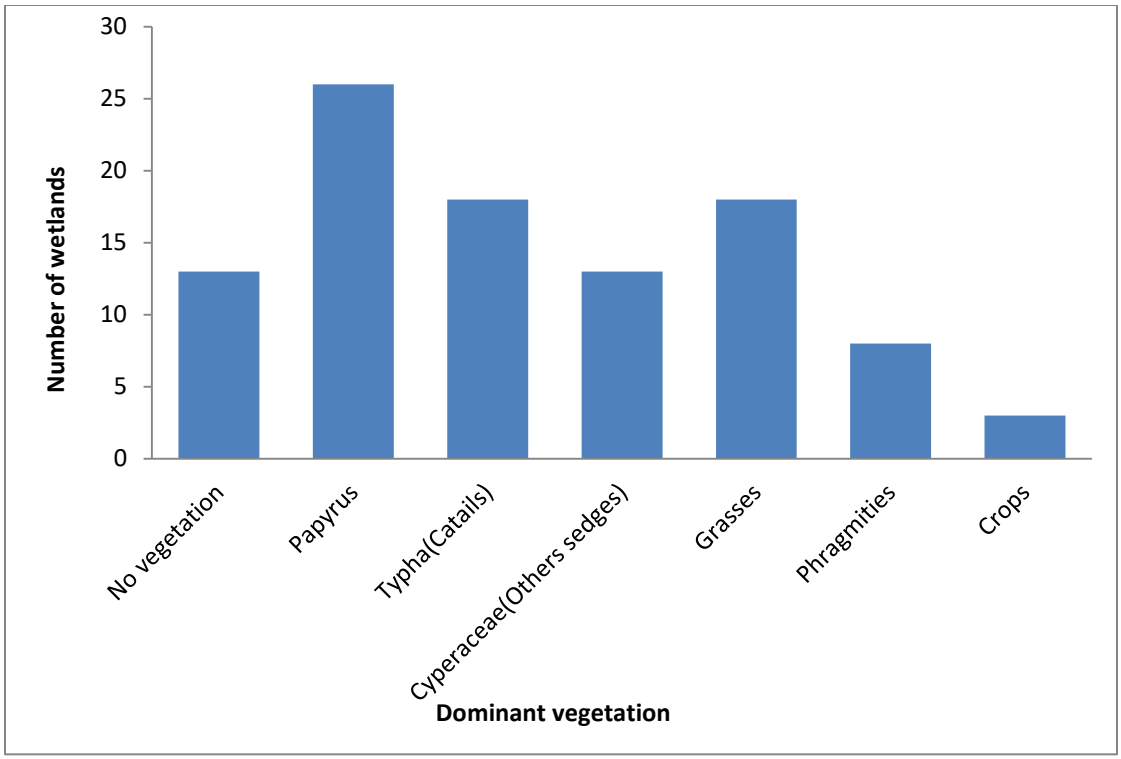


Figure 9: Dorminant vegetation in wetlands sampled

Table 7. Dominant Vegetation types common in selected wetlands within Mt. Elgon and Cherengany. Marked boxes indicate presence of the dominant vegetation

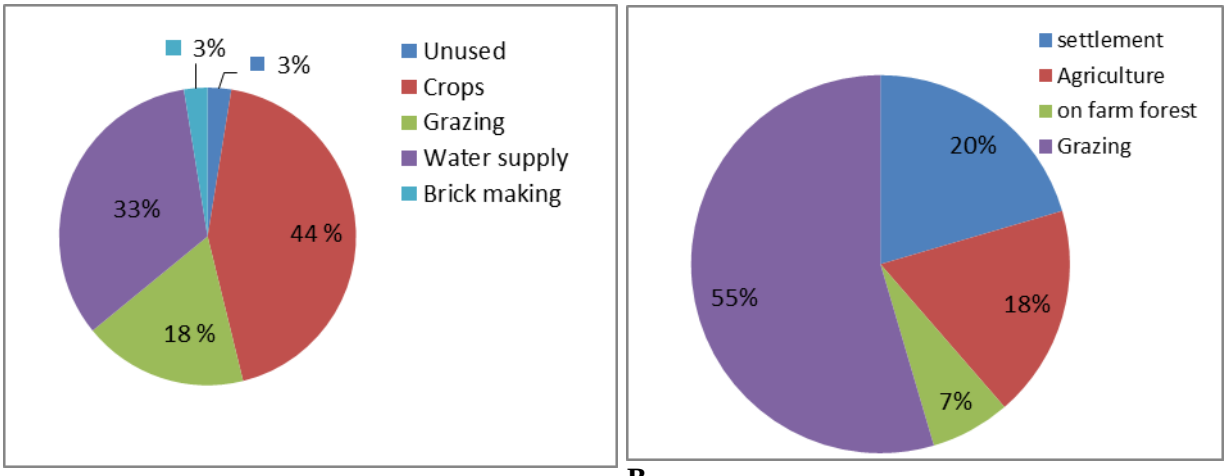
Wetland	No vegetation	Papyrus	Typha sp	Cyperus sp	Poaceae (Grasses)	Phragmities	Crops
Akiriamas wetland		X					
chebera dam			X				
chepkoilel		X					
dam	X						
dam wetland	X						
Dunga		X					
Hippo Point			X	X			
kamelilo						X	
kaplolong swamp				X			
keboswa dam	X						
kepchomo	X						
Kewa				X			
kimondy				X			
Kitale Nature Conservancy				X			
kobura irrigation							X
Ligega			X				
Lolmotio river		X					
Lukala					X		
Lunyerere		X					
Lunyu spring					X		
majengo			X				
maji mazuri			X				
malakisi river		X					
marura wetland		X					
matunda village					X		
Miti Jambazi					X		
Moiben river					X		
Mokoiwet Swamp		X					
Mokoiywet		X					
Muyuchi spring				X			
nzoia river			X				
outlet of pan paper ponds							
pan paper ponds							
Rafiki farm			X				
shilongo					X		

Wetland	No vegetation	Papyrus	Typha sp	Cyperus sp	Poaceae (Grasses)	Phragmities	Crops
Sio river wetland						X	
Sosiyo						X	
Turbo		X					
Ziwa					X		

5.4 Uses of Wetlands within Mt. Elgon and Cherengany Hills

5.4.1 Major wetland uses observed within the wetlands

The major land uses observed includes crop agriculture, livestock keeping (grazing) water supply and brick making. Crop agriculture was the most common land use (44%) that cut across all wetland types and categories. In rural part of the two water towers, grazing was also common and was responsible for the degradation of many natural wetlands. For example marshes dominated by grasses (poaceae) were primarily used for livestock grazing across all wetlands especially during the dry period and could be attributed to the degradation of small wetlands with sizes less than 500ha. Only 3% of the wetland surveyed could be categorized as unused. Nonetheless the unused wetlands were also once in use but had been abandoned over the years hence regenerating into a near natural state. Encroachment for crop agriculture is the most common pressure facing all the wetlands within Mt. Elgon and Cherengany.



A **B**

Figure 10: A) Activities within the wetlands and B) Activities outside the wetlands

5.4.2 Major land uses outside the wetlands

The major land uses outside the wetlands investigated included livestock keeping accounting for 55% of the wetlnds surveyed. Settlements was another major land use outside the wetlands. Others included agriculture and on farm forestry.

Table 8: Summary of wetland uses within Mt. Elgon and Cherengany wetlands

Uses	Examples
Tourism	Bird watching, nature walks, education in Kitale nature conservancy, L. Victoria, Yala swamp
Beekeeping	Honey and wax; pollination in Kakamega county wetlands
Water supply and use	Rural domestic water, urban domestic water, water for livestock, industrial water, and irrigation water
Wastewater Treatment	Sewage treatment in all major town within the counties
Fishing	Food and skins
Livestock Grazing	Meat, milk, and other livestock products in Kitale, Uasin Gishu, Kakamega, Kisumu, Siaya
Natural Herbaceous Vegetation Harvesting	Food, fuel, building materials, craft materials, mulch, and medicines in Busia, Kitale, Kakamega
Cultivation of Food and Fiber	Food and fiber
Plantation Tree Cultivation and Harvesting	Food, fuel/firewood, craft materials, building/fencing materials, and medicines
Human Settlement	Housing and industrial development

5.4.3. Threats to wetlands

The wetlands in Mt. Elgon and Cherengany are threatened. However, their condition is not as alarming, in the sense that they are within intervention limits. Encroachment of the wetlands for agricultural activities especially crop faming is in the single most common threat to wetlands within the two catchment areas.This was the case in both Mt. Elgon and Cherengany catchment areas (>30%) (Table 10 & Table 9). Grazing in wetland areas was alos observed to be quite common in the area (>25%). Invasive alien species (>15%) were quite common in many wetlands surveyed. The common invasive alien species recorded included *Eichonia crassipes* (water hycynth), *Salvinnia molesta* (Kariba weed) and *Azolla pinnata (mosquito fern)*. These invasives were more common in lentic ecosystems compared to the lotic systems. For instance swamps, marshes and artificial dams had the greatest incidences of species invasions.This is due to the fact that swamps and marshes are lentic systems hence the invasive species establish easily (Keddy, 2010). Additionally, marshes and swmaps accumulate nutrients (phosporous and nitrates) that facilitate proliferation of the

invasive species (GOPAL, 2009; Weber, 2017). These nutrients have their origin from agricultural activities in the riparian areas and in the catchment (Jordan et al., 2003). Other threats observed included water abstruction, settlement (14%), livestock grazing (13%) and pollution(11%).

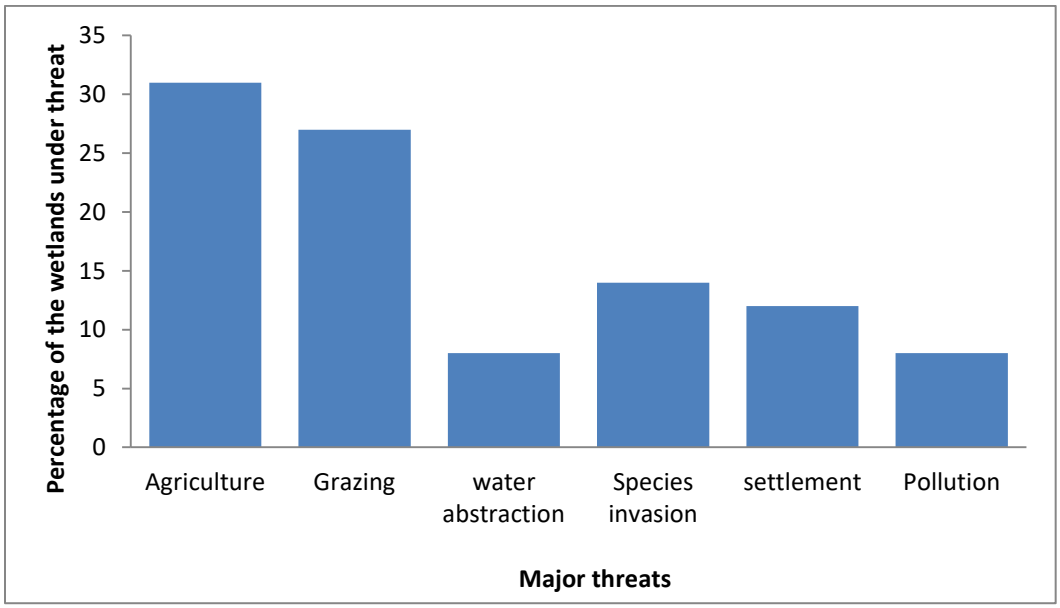


Figure 11: Proportion of threats observed against specific wetlands/springs

Table 9: Major threats to surveyed wetlands of Mt. Elgon and Cherengany. Marked boxes indicate presence of the threats

Wetland	Encroachment	Grazing	water abstraction	Species invasion	Settlement	Pollution
Akiriamas wetland	x					
Chebera dam						x
Chepkoilel	x	x				
Dam wetland			x			
Dunga	x	x		x		x
Hippo Point	x			x		
Kamelilo	x					
Kaplolong swamp				x		
Keboswa dam			x			
Kepchomo			x			
Kewa	x					
Kimondy		x				
Kitale Nature Conservancy						
Kobura irrigation	x	x				
Ligega		x				
Lolmotio river			x			
Lukala					x	
Lunyerere						
Lunyu spring					x	
Majengo		x				
Maji mazuri		x			x	
Malakisi river	x					
Marura wetland		x			x	
Matunda village		x				
Miti Jambazi	x	x				
Moiben river						x
Mokoiwet Swamp						
Mokoiywet	x			x		
Muyuchi spring						
Nzoia river	x	x				x
Pan paper ponds				x		
Rafiki farm	x					
Shilongo						x
Sio river wetland	x	x				
Sosiyo	x					
Turbo		X				
Ziwa		x			x	

CHAPTER SIX: CONSERVATION STATUS OF WETLANDS AND SPRINGS

6.1. Introduction

Elements recorded for the determination of conservation status of the wetlands/springs visited revolved around conservation threats at the sites, existing wetland biodiversity and existing measures that local residents/NGOs/CBOs have taken to protect it. Conservation threats observed from the field visit and literature included: Encroachment and drainage of wetlands for agriculture and settlement driven by population increase; Grazing within the wetland swamps; Unsustainable exploitation of wetland vegetation such as papyrus; Conflicts of open access wetlands leading to users setting fires to the vegetation and demarcation as private property; Damming and sedimentation of rivers; use of fertiliser and biocides inputs; Overcutting of wetland vegetation for handicraft industry and burning while opening up land for cultivation are the other threats facing the complex

6.2. Wetland Land Use and Land Cover Distribution

Representative wetlands used in the analysis of the the status of wetland were distributed in seven out of the eleven counties in the ecosystem working extent. The representative wetlands constituted a total of 69,353 ha, which consisted of land uses namely forest, shrubland, sedge/grassland, sedge/shrubland, cultivated areas and bare soil and or built up areas. Predominant vegetation in the Mt. Elgon and Cherengany ecosystems wetlands are sedges and shrubs occuring on the emergent areas of wetlands and on seasonal wetlands. Sedges and shrub covers in wetlands constitute a total of 35% of the wetland areas in the ecosystem. Sedges and grassland occurence forms about 18% of the wetland areas; however, this can as well be combined with sedges and shrubs as they overlap in some wetlands (Fig. 11). Thus, the vegetation community of sedges, grasses and shrubs constitute a total of 53% of the wetland areas in the ecosystem. Wetland areas with forest cover which constitute an estimate 8% of the wetland areas occur mostly in highland areas of the ecosystem.

Wetlands in the ecosystem experience a challenge of invasion by agricultural activities which has taken an estimated 26% of the wetland areas in the ecosystems. Some of the wetlands have the characteristics of bare soil or built up areas that takes about 11% of the wetlands in

the ecosystems. Thus, a total of 37% of the wetlands in Mt. Elgon and Cherengany ecosystems have been degraded severely. Open water areas occur mostly in the lower elevation of the ecosystems towards Lake Victoria which only constitute 2% of the wetlands.

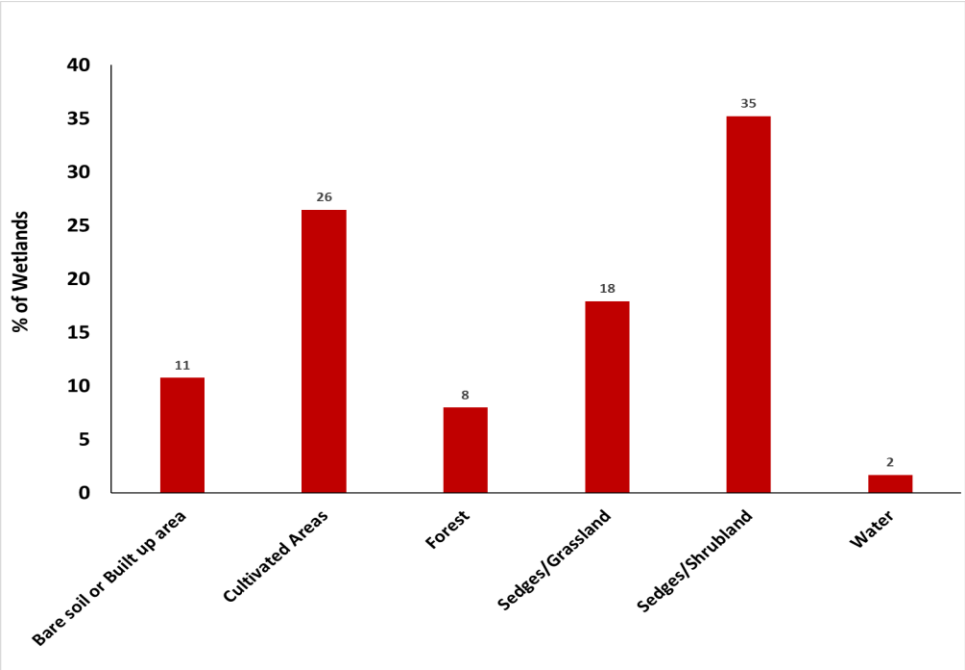


Figure 12: Distribution of Land Use Land Cover types in wetland areas in Mt. Elgon-Cherengany ecosystem

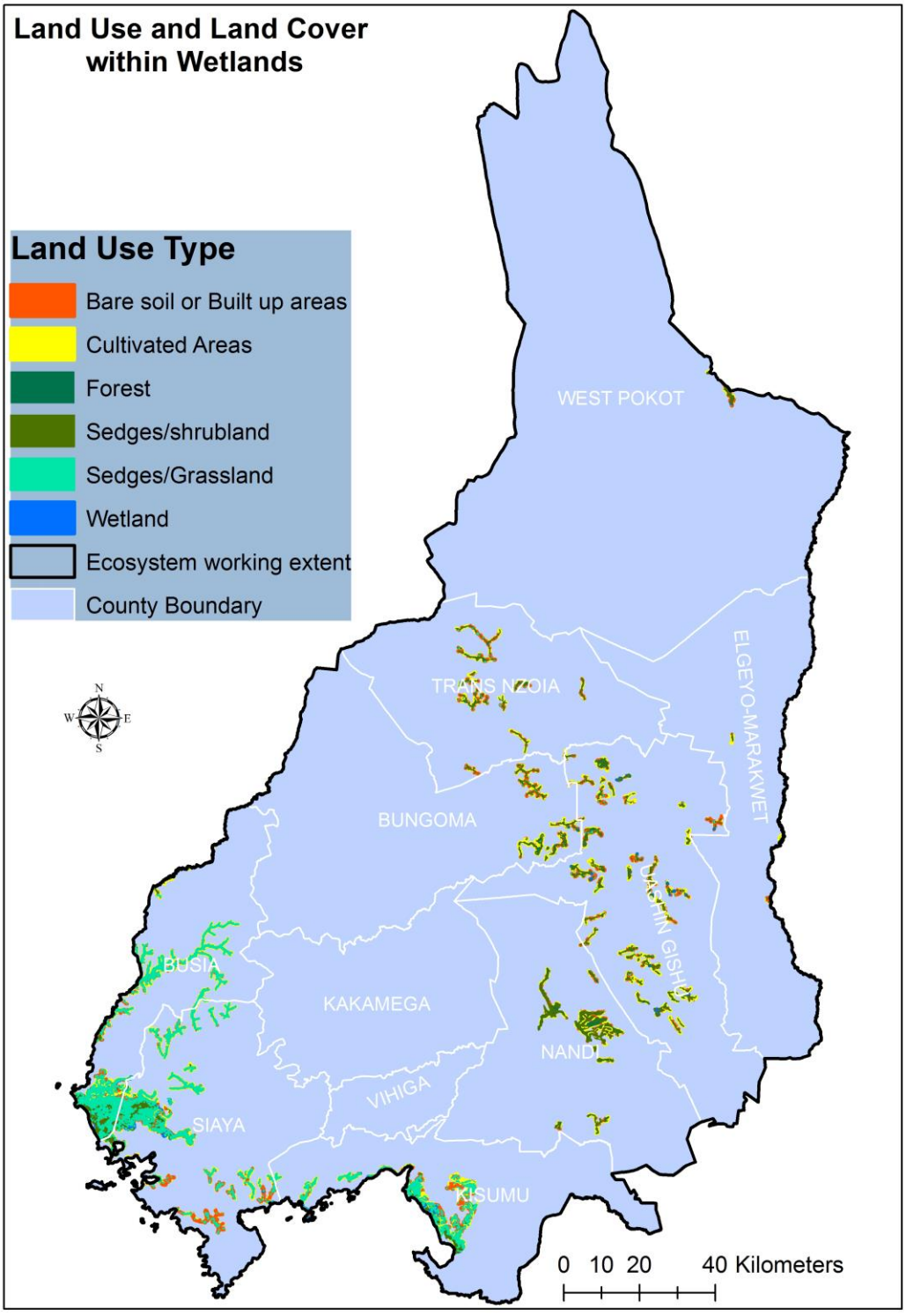


Figure 13: Representative wetlands used in the analysis of the distribution of Land Use and Land Cover types in Mt. Elgon and Cherengany ecosystems.

6.3. Population density around wetlands

An average population density distribution around wetlands in Mt. Elgon and Cherengany ecosystem is 298 persons per km sq. However, the density ranges from as low as 7 to 83,934 persons per km2. Representative wetlands indicate the highest population distribution occur around wetlands in Kisumu county, followed by Busia which has about 312 persons per km2. County with the least population density around the wetlands are West Pokot with the mean density of 8 person per km2 and Elgeyo Marakwet with about 61 persons per km^2.

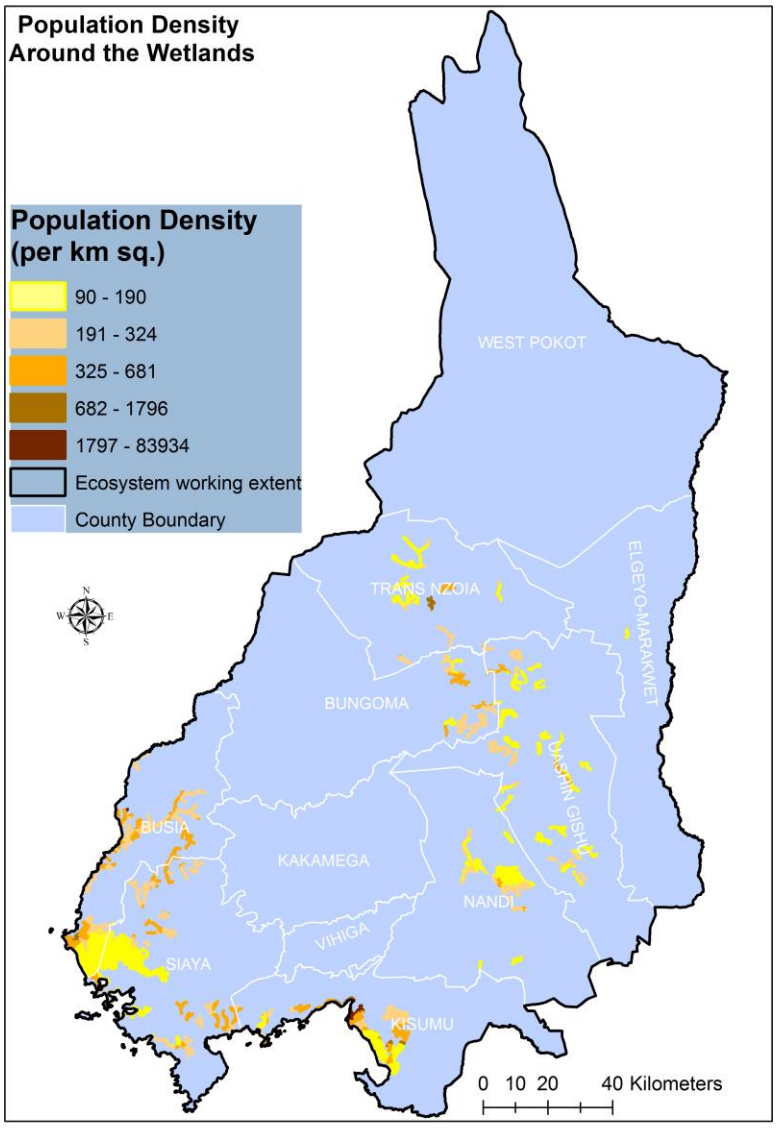


Figure 14: The mean population density spatial distribution persons per km^2 around the representative wetlands in the seven counties in Mt. Elgon and Cherengany ecosystems.

Table 10. The mean, minimum and maximum population density distribution around the representative wetlands

County	Mean	Minimum	Maximum
Bungoma	260	163	960
Busia	312	90	2461
Elgeyo Marakwet	61	31	191
Kisumu	620	102	7704
Nandi	175	57	485
Siaya	257	95	8393
Trans Nzoia	223	43	949
Uashin Gishu	161	55	552
West Pokot	8	7	11

High population density around the wetlands poses potential pressure on wetland resources. This is observed on how population density distributions occur around wetlands with certain types of land use and land covers. Highest population density occur around wetlands with sedges/grasslands (343 person per km^2) and open water areas (341 persons per km^2). Wetlands with cultivated areas has a mean population density distribution of 300 persons per km^2 around them; bare soil or built up areas have a mean population density of 286 persons per km^2. Wetlands with some forest cover around have the least mean population density distribution around them.

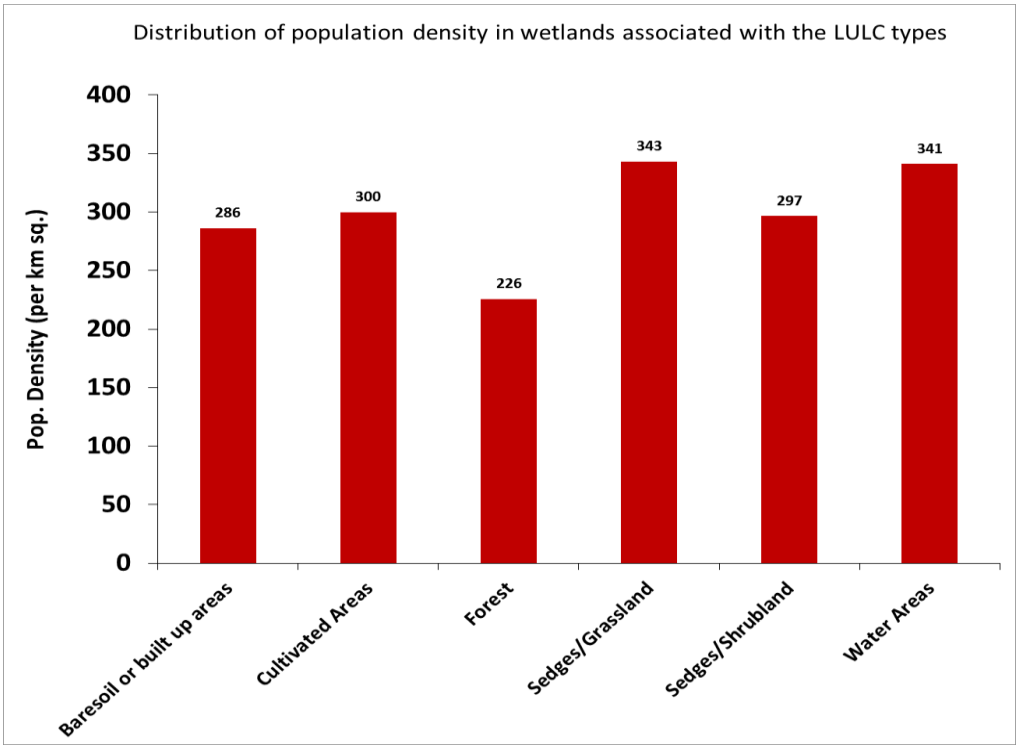


Figure 15: The distribution of population density around wetlands in Mt. Elgon-Cherengany ecosystems.

6.4. Riverine Land Use Land Cover (LULC) Distribution

The total lengths of the drainage network system used in this analysis is 12,578 km. Out of this length, 18% of the drainage network is intersected by riverine forest cover; shrub covers intersect 32% of the drainage network in the ecosystem; 3% of the drainage network has riverine grassland; cultivated areas cover 26% of the drainage network length; while 21% of the drainage network has bare soil or the drainage passing through built up areas.

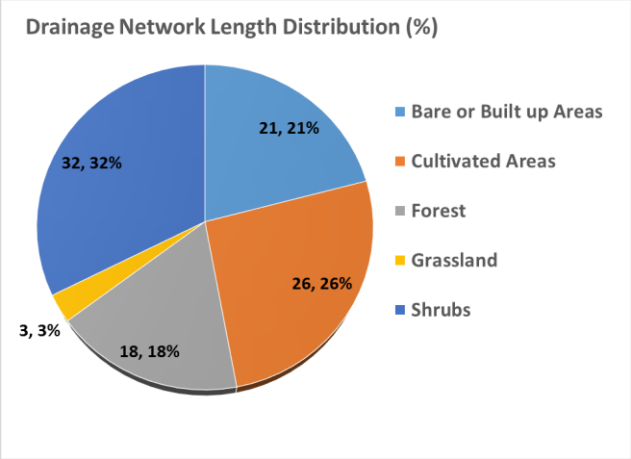


Figure 16: The riverine LULC distribution by length (%) of the drainage networks in Mt. Elgon and Cherengany Ecosystem

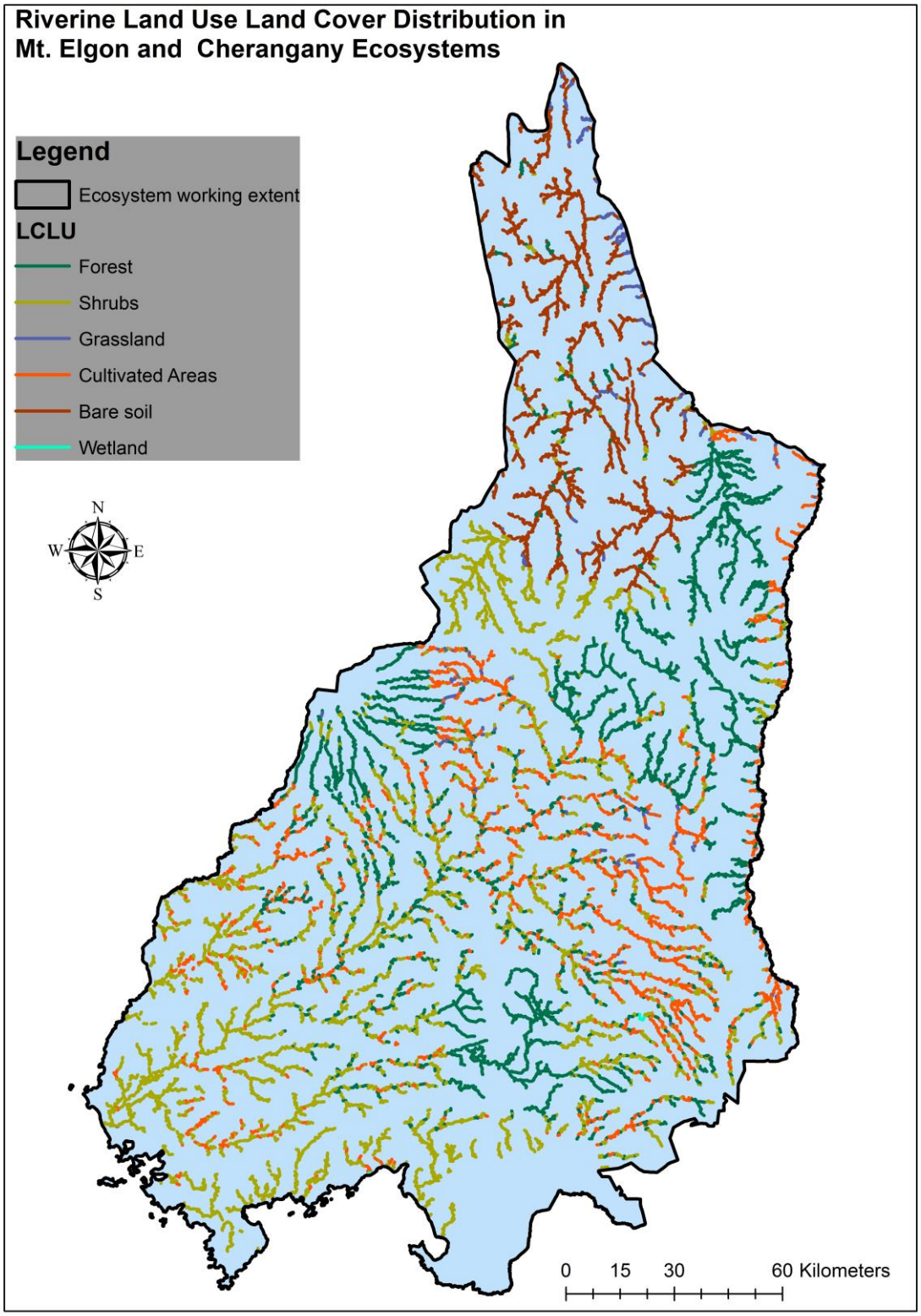


Figure 17: Riverine land use land cover distribution along the drainage networks in eleven counties in Mt. Elgon and Cherengany ecosystems

The distribution of LULC along the drainage networks in Mt. Elgon and Cherengany ecosystem forms riverine systems that are important for biodiversity distribution and conservation. Five major LULC consisting of cultivated areas, bare soil or built up areas, forest, grasslands and shrubland. The distribution of LULC along the drainage networks varies among the administrative counties. Shrub covers predominate riverines of the drainage networks in the ecosystems with 32%, However, the longest length of distribution of shrubs is in Nandi county (17%) followed by Bungoma (13%) and Kakamega (13%). Counties with least length of distribution of shrubs along the drainage network are Kisumu (3%), Vihiga (4%) and Busia (5%).

The length covered by cultivated areas and bare soil (or built up areas) along the drainage networks constitute 26% and 21%, respectively, of the total length of the drainage networks in the two ecosystems. Most distribution of the two LULC occur along the drainage networks in West Pokot county which has 60% and 37% of bare soil (or built up areas) and cultivated areas of the two ecosystems, respectively.

Riverine forest constitute a cover of 18% of the total length of the drainage network in the two ecosystems. The longest riverine forest occur in Bungoma county which constitute 24% the length of drainage networks in the ecosystems. The least length coverage of riverine forest are observed in Kisumu and Vihiga counties.

Riverine grasslands however, have the least length cover of 3% in the two ecosystems. While, 56% of the length of the total drainage network occur in West Pokot, followed by Trans Nzoia 18%, and Uashin Gishu 14% of the grasslands in the two ecosystem.

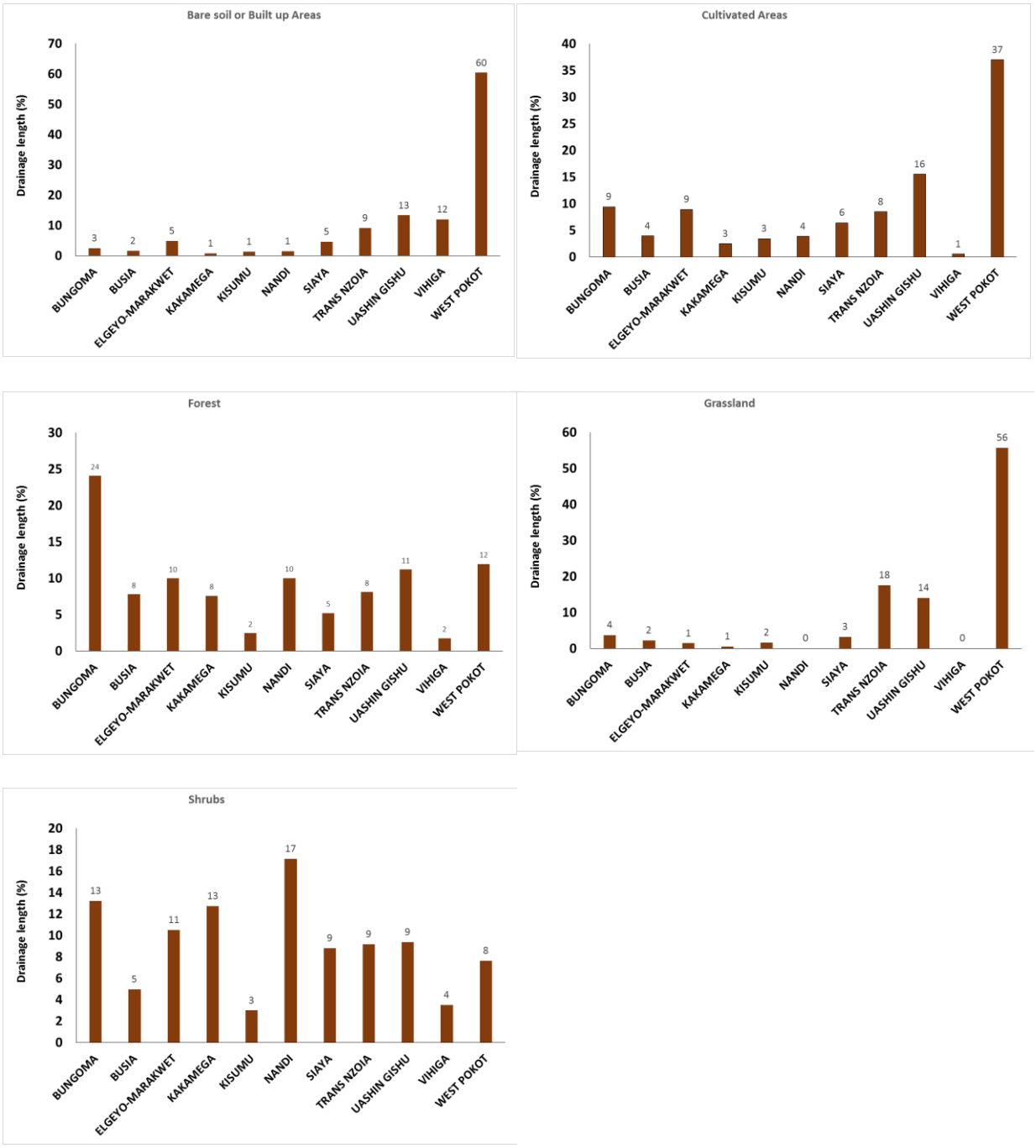


Figure 18: The distribution by length (%) of the land use land cover along the riverines on the drainage networks in Mt. Elgon and Cherengany ecosystems.

Table 11. Riverine LULC distribution along the length of drainage network based on the LULC in the ecosystems. *(The length covered by LULC in a county is provided in percentage (%) of the total area of the land use land cover in a county)*

	Bare soil or Built up Areas	Cultivated Areas	Forest	Grassland	Shrubs
BUNGOMA	5	21	37	1	37
BUSIA	8	23	31	1	36
ELGEYO-MARAKWET	12	27	21	0	40
KAKAMEGA	3	10	21	0	65
KISUMU	10	33	16	2	37
NANDI	3	12	21	0	64
SIAYA	15	26	14	1	44
TRANS NZOIA	21	25	16	6	33
UASHIN GISHU	23	33	16	3	25
VIHIGA	1	9	19	0	71
WEST POKOT	44	34	7	6	9

6.5 Soil erosion:

Plate 4: Cyperus papyrus Wetland endangered by river diversion and soil erosion

Signs of erosion activities such as rills and galleys on land near wetlands or on river banks were observed. Soil erosion is a threat because it destroys riparian areas where vegetation occurs thus opening up the wetland for subsequent sedimentation and siltation. Most of the

springs visited during field survey had minimal water trickling through due to silted reservoirs

6.6 Clearing of Vegetation

Plate 5: Wetland Vegetation Clearing

Occurrences of cleared patches of wetland vegetation were commonly observed. Clearing of wetland vegetation occur due to demand for vegetation for craft industry and construction. It was also noted in places where agricultural activities demanded more wetland to be cleared. This activity was observed to destroy vegetation and habitats.

Plate 6: Handicraft products and roof ceiling from wetland vegetation

6.7. Wetland Fires

Occurrence of burnt areas in the wetland near the wetland was also observed in some sites. Remains of char on wetland soil or bunt vegetation were the evidences observed.

Plate 7: Papyrus vegetation burnt to clear for agriculture

6.7. Livestock Grazing in Wetlands

Plate 8: Cattle grazing in wetland during dry season

The presence of livestock in the wetland was observed in a significant number of the sites visited. Grazing in the wetland affects the wetland system damaging the vegetation. When livestock penetrate into the thick wetland vegetation, they destroy safe areas for breeding of birds and habitat for reptiles and amphibians.

6.8. Agricultural Activities

Agricultural activities were observed to take place around or within the wetlands in most of the sites visited. Cultivation around wetland areas were observed to use irrigated water abstracted from the wetlands thus impacting on water balance in the wetland system. On the other hand, cultivation within wetland required draining of wetland water in order to moderate on soil water for growing crops. Draining water from wetlands for this purpose is one of the fastest routes to eroding and destabilizing the system and wetland functions.

Plate 9: Cultivation inside wetland with drainage channels

Plate 10: Water pump housing: for pumping water from wetland

6.9. Brick making

Brick making was also observed in a number of the sites. This is attributed to availability of suitable soils around wetlands and readily available water. However, brick making is a danger to wetlands as it destroys top soil and clears vegetation in wetland the affected areas.

Plate 11: Brick making in wetlands

Plate 12: Encroachment of built areas into urban wetlands

6.10 Urban Development activities

Urban development activities have been observed to be among the greatest threats to wetlands as they encroach into the wetlands thereby fast-tracking the process of wetland reclamation and or pollution. Release of toxic effluent into wetland areas is a common occurence impacting negatively on wetlands that are situated near urban centers. It was also commonly observed in several sites that some wetland areas were unlawfully being fenced off as private property while the law is very clear on how far development activities and privatization of land should be terminated without impacting on these fragile sites.

A

B

Plate 13: Illustration of negative impacts on wetlands (Wetland pollution from sewage disposal)

Untreated effluent released into streams draining through wetlands leads to habitat loss, poising and death of critical wetland biodiversity, loss of wetland ecosystem functions, loss of aesthetic beauty of the area to name but a few. This situation, together with construction of roads and buildings, blocking wetland inlets and outlets were also commonly noted in the area.

6.11 Illegal Acquision of Wetlands

Throughout the survey the team witnessed several instances where private properties were demarkated and fenced right into the wetland areas. This is a clear sign of lack of enforcement of the laws dealing with boundaries of wetlands and their protection. The following two photographs are a good evidence of the situation on the ground. It is quite common to find wetland areas fenced off as private property. Even the cultivated wetland areas are supposedly owned by individuals as private property.

A

B

Plate 14: Photos showing land property fenced right inside wetland area A) near uran settlent and B) in farmland

6.12 Socio-economic use of wetlands by local communities

The current study has gone ahead to reaffirm that besides the ecological functions of wetlands, they ae greatly valued by local communities who cite direct benefits that they derive from these areas. The ease with which communities living around wetlands access water for their farms and even domestic use cannot be overemphasized. Apart from drawing water from springs, a significant number of homes were found to have constructed shallow water wells in their homes due to the high water tables supported by wetlands. Some of the villagers indicated that they wells were as shallow as 10m deep and that they had plenty of water throughout the year. However, some wells were reported to have started drying up

A

B

Plate 15: Abstraction of water for domestic use (A a spring; B a shallow water well)

Plate 16: Fish ponds constructed within awetland

The use of wetlands for the construction of fish ponds was also cited by famers as convenient since the water is readily available. The negative aspect was that some of these ponds were constructed at the expense of communities downastream especially during dry seasons.

Most of the wetlands in the study area are surrounded by farming and settlement activities. It is evident that the pressure of intensification of development or agricultural activities (resulting from population growth) and associated activities around and within wetland ecosystems in the study region is real and of grave concern. This is considered one of the key threats impacting negatively on the ability of these ecosystems to support their ecological functions and act as critical habitats for biodiversity. These habitats are especially vulnerable to further degradation through development if no action to reverse the current trends is taken. Other observed threats to these habitats include dumping of solid waste, over abstraction of water, encroachment for commercial and residential use, overgrazing in the wetland area and improper land use practices arouond the watershed.

Plants of Economic Importance

Table 13 below provides a summary of some of the common plants recorded from the wetlands in the study area and their common uses.

Table 12Wetland plants and their uses

Plant use	**Species**
Vegetables	*Basella alba, Commelina sp., Crassulaalsinoides* sp.*, Cyphotemma sp., Rumex usambarensis, Solanum niram, Polygonum sp.*
Fruit trees	*Syzygium guineense, Trema orientalis, Rhus natalensis, R. longipes, Dalbergia lacteal. Trichocladus ellipticus* (used as a milk sweetener). *Ficus sycomprus* and *F.*
Fodder plants	*Cyperus sp., Schoenoptectus spp., Eleusin spp., Pennisetum spp., Cymobopogon spp., Lotononis spp., Echinochloa spp., Basella alba., Acacia sp., Aeschynomene sp., Ficus sp., Sesbania,* and *Vernonia sp.*
Building	*Acacia sp., Celtis africana, Nuxia congesta, Salix subserrata, Ficus, Rhus longipes, R. natalensis, Phoenix reclinata, Zanthxylum usambarense, Syzygium guineese, Vernonia amygdalina*. Species used in thatching are*: Cyperus sp., Eleusine indica, E. jaegri, Pennisetum sp., Cymbopogon, Setaria sp.* and *Digitaria sp.*
Medicinal	*Acacia lahai, A. seyal, Rhammus prinoides, Zanthoxylum usambarense, Polygonun sp.* and *Solanum incanum.*

CHAPTER SEVEN: AGRO-FORESTRY AND SOIL CONSERVATION TECHNOLOGIES FOR REHABILITATION

7.1 Introduction

Despite escalating threats to the wetlands due to human activities as reported in this study the Mt Elgon-Cherengany Ecosystem remains a key site for biodiversity and water catchment for the country. Susequently, this calls for urgent measures to protect those sites that are still viable wetlands from further fragmentation and drainage to preserve their ecosystem fucntions and livelihoods that are supported by these ecosystems, not to mention biodiversity conservation. Current study has identified agriculture and poor land use practises as the key drivers of the threats facing wetlands in the region. It is therefore imperative that one of the key measures that must be taken to conserve and or rehabilitate the degraded wetland /spring sites is identification and implementation of appropritae agro-forestry and soil conservation technologies.

The adoption, in 1971, of the Convention on Wetlands of International Importance, especially as Waterfowl Habitat (Ramsar Convention) marked a turning point in the conservation of wetlands. The Convention, which Kenya acceded to on 5th June 1990, requires contracting parties to conserve and wisely use wetlands. Further, the parties are required to include wetland conservation considerations into their natural resource planning processes, and this requires a supportive and effective legal and policy framework.

Past efforts on soil conservation have focused on technological innovationsin to control and mitigate soil erosion. However, land degradation in most parts of the world, Kenya included, has continued to accelerate due to demands for continued economic development, using technologies that are highly exploitive. This has been facilitated by inadequate institutional, legislative, and policy environments. Hence efforts to mitigate land degradation need to shift from studies of the biophysical processes to improving enabling policy environment, as well as mainstreaming of soil conservation into national and regional (county) policies and programs in addition to law enforcement.

7.2 Proposed Specific Technological Measures

There are isolated documented efforts seeking to improve the productivity and sustainability of land use systems in selected watersheds in western Kenya (e.g. Njuguna, 2004). However, no deliberate attempts have been made to conserve the seemingly threatened wetlands. The process of watershed improvement involves several important aspects. Some of these include the selection and application of technical methods for bringing about stabilization of degraded land surfaces through the reversal or stoppage of degradation, or protection against it in newly exposed watersheds. Similarly, addressing the loss in agricultural productivity due to diminished soil and nutrient status has also been used effectively.

Specific measures include agronomic practices, farm and range plants for erosion control and water conservation, forestry, contouring, terracing, water disposal, tillage operations, gullies, dams, water spreading, wildlife, and flood control. Proponents of agro-forestry consider trees as investments made by economic agents to prevent depreciation of natural assets such as stocks of top soil and water (e.g. Pattanayak & Mercer, 1998). These can be implemented as either on-sight or off-site:

7.2.1 On Site

7.2.1.1. Arable land

Contouring with vegetative (e.g napier grass) barriers. This approach was found most productive in a study using calliandra (*Calliandra calothyrsus* Meissner), leucaena (*Leucaena trichandra* (Zucc. Urban) and napier grass (*Pennisetum purpureum)* (Schumach) and a combination hedges of either calliandra or leucaena with napier grass on slopes (Mutegi *et. al*., 2008). Hedge plots were monitored for soil fertility, soil losses and maize crop yield changes. In general, it was reported that the combination hedges seemed to provide the best solution for reducing soil erosion, combined with improvement of maize crop yields and soil fertility enhancement. We propose that this method can also be applied in the rehabilitation of riparian wetland habitats.

Contouring with earth banks and waterways. It has been observed that contour banks are designed to reduce the flow velocity of overland flow and to intercept water before it concentrates in rills, thereby reducing the risk of soil erosion and land degradation. In a study by Stuedel *et. al.* (2015), an approach was developed to improve distributed hydrological and erosion modelling by integrating contour banks in the delineation and routing of Hydrological Response Units. These can either be applied as earth banks on field boundaries, furrowing, ridging, and ridge tying.

Tillage practices such as subsoiling has been documented to improve water percolation (Pikul and Aese, 2003) and hence could be a useful practise. Besides, excess water percolation has potential to leach nitrate-N from soil profile.

Vegetative ground cover, mulching and manuring: The investigations of this technique indicated that there are significant and important differences in runoff generation and sediment production with respect to the different types of vegetative cover. Forest and natural vegetation treatments exhibited the lowest amounts of runoff (Mohammad & Adam, 2010). Grass cover, grass strips, grass barriers have also been shown to yield similar results.

Improved farming (cropping) systems. Investigations of organic farming have demonstrated greater long-term soil benefits than conventional no tillage practices, despite the use of tillage in organic farming.

Agroforestry**.** It has been argued that domestication of indigenous trees with high-value products enhances profitability, particularly those that can be marketed as ingredients of several finished products (Sanchez, 1995). Policy research interventions are often necessary to help farmers during the initial years before trees become productive and exert their positive ecological functions. Profitable agroforestry systems are potentially sustainable, controlling erosion, enhancing biodiversity and conserving carbon, provided nutrient offtake is balanced by nutrient returns via litter and the strategic use of fertilizers, particularly phosphorus. Table 13 below provides information on trees under Agro-forestry found on community farm land around the Mt Elgon National Park.

Table 13: Agro-forestry trees found in communities around the Mount Elgon National Park

Purpose	Species	Source of information
Agroforestry	• Grevillea robusta[2] • Maesopsis eminii • Fucus natalensis • Markhamia lutea • Ricinus communis • Ekebergia ruppeliana • Eucalyptus grandis2 • Ficus ovata • Napier grass[1]	UWA official per. com; Reed and Clokie, 2000
Agro-forestry and Fodder	• Leuceana leucocephala[2] • Caliandra calothyrus[2]	Key informants
Support for beehives	• Calliandra calothyrus • Cordia Africana2 • Sesbania sesbans2 • Sesbania bispinosa2	Key informants
Tree species under plantation forestry	• Cyperuss lusitanica • Pinus patura • Pinus radiate • Ecalyptus saligna • Eucalyptus grandis	Observation and UWA official These trees are all exotic

[1]*Napier grass is planted on terraces to reduce soil erosion and also as fodder. It is also a min food supplement for cattle in zero grazing systems (Reed & Clokie, 2000)*

[2]*main trees species promoted by IUCN during the concluded MECDP*

Adapted from: MEICDP, (2000). A 5-Year Tourism Strategy Framework for the Western Region of Kenya with Specific Focus on Mt. Elgon National Park Part I (Final Report, June 2000. Report, unpubl.

Land leveling and smoothing.

Land leveling is a form of soil disturbance that alters soil physical properties and is commonly conducted in fields such as rice fields to facilitate more uniform distribution of irrigation water (Brye et al, 2005).

7.2.1.2 Non-arable land

Vegetative barriers on the contour has been used as an effective soil and water conservation mechanism. This can be achieved through afforestation, reforestation or revegetation. Similarly, earth or rock barriers can be used for the same purpose. Poor water quality due to poor soil and water conseravtion measures and use of exotic trees as vegetative barriers (Plate 17) was observed in some of the wetlands visited. The benefits of using indigenous trees should be explored. Some of the agro-forestry tress listed in Table 12 can be used for this purpose.

A. Sergoit Wetland (Uasin Gishu)

B. Miti Jambazi (Trans Nzoia)

Plate 17. Poor water quality due lack of vegetative barriers or use of inappropriate vegetative barriers

Silvipastoral plantations. Cattle rearing is a common practice among many communities within Mt Elgon and Cherengany ecosystems. For this reason, mechanisms to reduce grazing pressure, stall feeding pasture improvement are recommended for soil and water conservation.Plantations have been evaluated for their potential as silvopastoral systems, and the possibilities of integrating local farmers into their appropriate sustainable utilization has been documented (Garrison and Pita, 1992). Grazing was a major landuse posing threat in most wetlands visited (Table 1; Plate xx). In such cases, the adoption of silvipastoral planatation technologies is recomemnded to redice pressure on the wetland ecosystem.

A) Miti Jambazi Swamp (Trans Nzoia)

B) Sosiyo Swamp (Uasin Gishu)

Plate 18. Grazing as a land use within wetlands visited

Buffer zones. A study of buffer zones in Europe showed that organic farming enhanced the biodiversity of plants and birds in all landscapes, but only improved the potential for biological control in heterogeneous landscapes (Winqvist *et al*, 2011). This study underscored the importance of taking both local management and regional landscape complexity into consideration when developing future agri-environment schemes, and suggest that local-regional interactions may affect other ecosystem services and functions. For instance, poor farming practices were documented in many places such as Busia (Plate 17) without consideration of buffer zones around the wetland.

Plate 19. Agricultural encroachment within wetland in Malakisi River Swamp (Busia)

Trail, rural road and forest road constructions. Owing to the fact that most wetlands are found within human-settled landscapes, infrastructural developments such as trails, rural and forest roads are unavoidable. However, if not well designed and managed, these pathways could lead to serious negative impacts in terms of soil and water loss.

7.2.1.3 Drainage lines

Gully control structures. Preventing the effects of soil erosion is an essential part of good catchment management. This can be achieved through check dams and silt traps. In the field such as riparian wetland habitats, it is not only important to select the most efficient erosion control measures but also to determine their optimum location in the catchment (Mekonnen *et. al.*, 2015). Other techniques include diversion drains and vegetative stabilization of natural drainages. This is most appropriate especially around springs (Table 1). Many springs visited during this study were highly degraded due to poor management practices within the

catchment. Proper gully control structures are proposed as part of the rehabilitation for such springs.

A B

Plate 20. Impacts of catchment degradation in A Muyuchi and B Lunyu springs (Kakamega)

7.2.2 Off-Site

While considerable effort must be put on site, it is equally important to take some measures off site as well.

Drainage lines. Management of drainage lines has been achieved by either grassing of artificial waterways or stream bank protection. In other circumstances, channelization has also been used. Some of the local within the visited wetlands already adopt this techniques (Plate 21). This should be further promoted in other areas.

Plate 21. Channelization in Kewa Swamp (Uasin Gishu)

Compacted areas. Construction of roads often result in high soil compaction mechanisms. This usually leads to increased run-off and soil loss. Some of the techniques that have been proposed to mitigate such effects include proper design and retaining walls for cut barriers. Settlements such as the ones observed in Kisumu (Plate 21) require adequate diversion drains for similar reasons.

Plate 22. Peri-Urban development in Hippo Point Swamp (Kisumu)

CHAPTER EIGHT: CONCLUSION AND RECOMMENDATIONS

Current study indicate that the majority of wetlands within the Mt Elgon-Cherengany Ecosystem are on private farmlands with no formal protection and many are under considerable threat. They face a variety of problems, including pollution from industry, sewage or agricultural run-off (e.g. Nzoia River), excessive off-take of water for irrigation, large-scale projects involving damming or drainage (Yala Swamp), and siltation arising from soil erosion in the degraded watersheds.

Reclamation of wetlands for agriculture in both both Mt Elgon and Cherengany is of great concern, as modification of wetlands is also taking place rapidly. The use of pesticides and fertilizers in agriculture is a potential problem, and could threaten biodiversity both directly (through poisoning) or indirectly (through eutrophication of aquatic habitats). Anecdotal reports on a number of dead birds such as raptors and storks being encountered in agricultural areas including Elgon and Busia grasslands indicate the need for action to protect them againt poisoning.

Most of the threats identified are tied to pressing issues of human well being. Solutions for conserving these ecosystems in the region will therefore depend on solutions for people and many of these critical issues are beyond the means of conventional conservation. To be successful in the long run, conservation efforts must enroll the support of people living around protected areas. Promotion of bird conservation goes hand-in-hand with efforts to promote wise use of the environment and the conservation of biodiversity in general. In July 1990 Kenya became a signatory to the Ramsar Convention which advocates for wise use of wetlands. This encouraging action paves way towards protection of the country's most important wetlands and associated water birds under the convention.

Kenya's environmental concerns extend much further than biodiversity alone, and conservation efforts must take place across a broad front if they are to be effective. Nonetheless, there are good reasons to concentrate on biodiversity in particular and a strategy to conserve birds in particular, validly forms part of an overall plan for wise use of the environment. Kenya's environmental concerns extend much further than biodiversity alone, and conservation efforts must take place across a broad front if they are to be effective.

Nonetheless, there are good reasons to concentrate on biodiversity conservation and, a strategy to conserve birds in particular, would validly form part of an overall plan for wise use of the environment and wetlands for that matter. Much as the Wildlife Act gives protection to the majority of bird species, the protection of birds in the Act is very general and not well defined.

The wetlands visited were mainly characterized by rivers, springs, swamps and dams. The wetlands range from various sizes and are also under different management systems. The management ranged from communal, private and government to open access wetlands consequently exhibiting varying levels of threats and biodiversity importance. Different land use systems were noted within and outside the wetland. These included mainly farmlands. Both ecosystems are located in high agricultural potential area with farming ranging from small to large scale mechanized farming systems. Our findings reveal that expansion of farmlands is by far the greatest driver of land use changes in the region and the escalating human population. These have resulted in degradation and fragmentation of wetlands due to clearing and draining wetlands to open up areas for farming.

Mt Elgon – Cherengany environmental concerns extend much further than wetlands and springs alone. Subsequently conservation efforts must take place across a broad front if they are to be effective. In view of the observations made during this study the following series of recommendations are proposed for follow up and implementation:

8.1 Recommendations

8.1.1 Education, Awareness Creation & Empowerment of Local Communities

The old adage "***information is power***" still remains true even in the current setting. A follow-up series of public awareness and education campaigns to sensitize the local communities on the importance of the two ecosystems could change attitudes and perceptions. There is need to introduce ventures that can help address many of the above threats. Public education and awareness of the benefits of biodiversity conservation, adoption of wetland user-friendly alternatives, and sustainable income generating

Plate 23: A sign post within a wetland in Trans Nzoia County

enterprises could offer a unique opportunity to sustainably manage and conserve wetlands amidst increasing population, poverty and limited resources. From the foregoing report, it is emerging that NGOs and Civil society play a significant in role in conservation and are desirable partners in the conservation of Wetlands. This is exemplified by the Kitale Nature Conservancy that exhibited one of the best conserved wetlands among the wetlands visited. They have a comprehensive education and awareness program (e.g Plate 17). Both Mt. Elgon and Cherengany hills forest ecosystems are internationally recognized as Important Bird Areas (IBAs) (Birdlife International, 2017).These important bird areas extend beyond the existing legislated protected area boundaries. Hence the IBA approach to biodiversity monitoring and conservation provides a viable concept for conservation of birds and other biodiversity through involvement of local communities outside the jurisdiction of protected area system, and this subsequently conserves the appropriate habitats as awell. Patnerships

with local CBOs, NGOs, International organizations with a local presence is therefore highly desirable for awaress creation and subsequent conservation.

Creativity and innovative thinking in conservation of wetlands has the potential of generating income to local communities. During the field survey the team visited Dunga wetland area in Kisumu where community based group, ***Dunga Ecotourism and Environment Group*** (Plate 18) has come up with ways of conserving the rich *Cyperus papyrus* wetland while earning a living out of it. The group has constructed board walks and created view points by the L. Victoria shore providing a scenic view of the lake (Plates 19 & 20). Aggressive marketing and promotion of such sites has the potential of increasing visitation and income to the local communities.

Plate 24. Part of the resource center in Dunga Swamp

A

B

Plate 25 A. A newly constructed board walk and B. A watch tower in Dunga

Such initiatives could also target improved participation of women and youth in nature-based income generating activities at local levels by; enhancing capacity and knowledge in managing tourism activities and provision of essential birding equipment to encourage them to actively participate in bird-guiding in bird-rich wetland areas**.** Ventures of this nature would go a long way to generate jobs for rural Kenyans while reducing the pressure on wetlands created as a result of direct use. Other nature-based income generating activities noted included; weaving of chairs and mats from papyrus strands and other wetland vegetation including Water hyacinth (a perceived threat to fishing industry in the region); tour guiding; horticulture and establishment of tree nurseries. Creating a demand for higher quality products could enhance product development skills and enhance community benefits. All these, if done sustainably, have the potential of leading to a win-win situation in terms of conservation and wise use.

Training community members on diverse and sustainable nature-based entrepreneurial ventures will significantly enhance community involvement in wise use and subsequently, the conservation of these wetlands. Furthermore, it is recommended that platforms be created for sharing experiences and lessons learnt by successful communities to empower others in the region to develop similar initiatives in other suitable wetland areas. This will provide opportunities for spreading best practices, thus going a long way in preserving these valuable ecosystems.

Similar initiatives have been reported for Kakamega forest where there are guides who are self-employed in the forests, working solely as tour guides. Their livelihoods are obviously enhanced compared to counterparts without any form of income. Experiences in Kakamega forest indicate that with some support, local communities can become professional guides and they can act as a nucleus for wider community training and sharing lessons learned.

Indications of wise use of wetlands was also noted especially in Webuye where constructed wetland ponds act as natural filters for a variety of pollutants from the surrounding catchment, and also effectively removes silt before the water is discharged into R. Nzoia and onward to L. Victoria.

8.1.2 Laws, Regulations and Policies

Most of the communities interviewed during the study decried the fact that there is no proper wetland management structures on the ground. The communities claimed that they have been left to manage these sites on their own hence the rampart fencing-off wetland areas as private property to the detriment of the wetlands. Most of the springs visited were in disrepair much as the local communities are in dire need of water from the same.

A Master Plan for the Conservation and Sustainable management of Water Catchment Areas in Kenya was published by the Ministry of Environment in 2012 followed thereafter by the development of Wetland Policy which is still a draft bill (2013). These are comprehensive documents which provide for the conservation of wetland catchment areas viz. the environment, water, wetlands, forests and land, in addition to those governing wildlife, agriculture and physical planning. It is however, unfortunate to note that despite existing policies and legal frameworks, there still lacks a comprehensive framework to addresses the governance of wetland catchment areas up to local levels, primarily due to the fact that this issue straddles several sectors ranging from water, wetlands, agriculture to land. Even with the existing legal and policy framework, there is a considerable void when it comes to enforcement. A desirable attempt has been made in the current draft wetland policy with proposed policy statements which would go along way in consolidating and harmonising some of the management/conservation issues observed in the region studied (National Wetlands Conservation and Management Policy Draft, 2013): The potential powerful policy statements in the draft are as follows;

The Government shall:

Policy Statement 1: Ensure that any drainage, conversion, burning, alteration of a wetland, or introduction of alien and invasive species in a wetland will be subjected to approved standard procedures including Environmental Impact Assessment (EIA), Strategic Environmental Assessment (SEA), Cost Benefit Analysis (CBA), and adequate public participation.

Policy statement 2: Promote restoration and rehabilitation of degraded wetlands.

Policy Statement 3: Undertake socio-economic valuation of wetlands to inform planning and decision making.

Policy Statement 4: Harmonize wetland riparian (buffer) zones and setback limits for all wetland ecosystems in the country.

It is therefore recommended that a comprehensive review, harmonisation, application and enforcement of policies, legislations, regulations and standards governing wetland water catchments is undrtaken for effective conservation of these critical ecosystems

8.1.3 Waste and Effluent Disposal

Wetlands in the neighborhood of urban areas were observed to be particularly vulnerable. It is recommended that urban and industrial waste management adhere to proper disposal and sanitation systems to protect those wetlands that are in the neighbourhood of urban centers. Enforcement of appropriate laws governing waste management should also be applied. Construction and use of man-made wetlands for cleaning up toxic elements from effluents before discharging into streams should also be encouraged.

8.1. 4 Alternative Livelihoods

The study recommends identification and promotion of alternative livelihoods through small to medium size enterprises that are necessary for sustaining ecological quality of wetlands. This will check the over-reliance on natural wetland resources. The example of Dunga Ecotourism Project in Kisumu presents a successful story for sustainable use of wetland resource that focuses on improving livelihoods while preserving biodiversity. Public awareness of the benefits of biodiversity conservation coupled by adoption of wetland user-friendly alternatives, and sustainable income generating enterprises offers a unique opportunity to sustainably manage and conserve wetlands amidst increasing population, poverty and limited resources. Observations were made of diverse income generating activities based on wetland resources which currently appear to be a threat to the conservation of wetlands, such as massive harvesting of papyrus vegetation for handicraft industries. Such activities can be turned around to be a point of entry in educating and training the locals on sustainable and wise use of these valuable resources. Furthermore,

other nature based enterprises such as Bee keeping, butterfly farming, sustainable fish farming, silkworm farming, etc could be promoted in all the counties.

8.1.5 Soil Erosion and Land degradation

Signs of erosion activities such as rills and galleys on land near wetlands or on river banks were observed. Soil erosion is a threat because it destroys riparian areas where vegetation occurs thus opening up the wetland for subsequent sedimentation and siltation. Most of the springs visited during field survey had minimal water trickling through due to silted reservoirs. It is therefore recommened that appropriate technologies be applied to reduce on soil erosion and silting of the wetlans and springs. Technologiesthat have been identified in this study include: Promoting *agroforestry around the catchment,* contouring with vegetative (e.g nappier grass) barriers, contouring with earth banks and waterways, tillage practices such as sub-soiling, improved farming (cropping) systems, vegetative ground cover, mulching and manuring.

8.1.6 Rehabilitation of Springs

All the springs visited were constructed and protected for use by local communities in the early 20th century by colonial government and had been used decades with not much rehabilitation efforts. Their conditions were observed to be in disrepair with minimal water trickling through. The communities were however, still using them and they all wished to have them rehabilitated to enhance the flow of water for their domestic use, especially in areas where these were the only sources for drinking water. It is recommnded that a spring rehabilitation programme be initiated by relevant government structures to restore the springs for local use.

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APPENDICES

Appendix 1: List of bird species in Mt. Elgon-CherenganyCherengany Hills Ecosystem

Family Name	English Name	*Scientific Name*	Elgon	Cherengani
Accipitridae	African Crowned Eagle	*Stephanoaetus coronatus*	x	x
Accipitridae	African Goshawk	*Accipiter tachiro*	x	x
Accipitridae	African Harrier Hawk	*Polyboroides typus*	x	x
Accipitridae	Augur Buzzard	*Buteo augur*	x	x
Accipitridae	Ayres' Hawk Eagle	*Hieraaetus ayresii*	x	
Accipitridae	Bateleur	*Terathopius ecaudatus*	x	
Accipitridae	Black Kite	*Milvus migrans*	x	x
Accipitridae	Black-shouldered Kite	*Elanus caeruleus*	x	
Accipitridae	Booted Eagle	*Hieraaetus pennatus*	x	
Accipitridae	Common Buzzard	*Buteo buteo*	x	x
Accipitridae	Crowned Eagle	*Stephanoaetus coronatus*		x
Accipitridae	Dark Chanting Goshawk	*Melierax metabates*	x	
Accipitridae	Egyptian Vulture	*Neophron percnopterus*	x	
Accipitridae	Eurasian Honey Buzzard	*Pernis apivorus*	x	
Accipitridae	Great Sparrowhawk	*Accipiter melanoleucus*	x	x
Accipitridae	Hooded Vulture	*Necrosyrtes monachus*	x	x
Accipitridae	Lammergeier	*Gypaetus barbatus*	x	
Accipitridae	Little Sparrowhawk	*Accipiter minullus*		x
Accipitridae	Lizard Buzzard	*Kaupifalco monogrammicus*	x	
Accipitridae	Long-crested Eagle	*Lophaetus occipitalis*	x	x
Accipitridae	Martial Eagle	*Polemaetus bellicosus*	x	
Accipitridae	Mountain Buzzard	*Buteo oreophilus*	x	x
Accipitridae	Osprey	*Pandion haliaetus*		x
Accipitridae	Ovampo Sparrowhawk	*Accipiter ovampensis*	x	
Accipitridae	Pallid Harrier	*Circus macrourus*	x	
Accipitridae	Rufous-breasted Sparrowhawk	*Accipiter rufiventris*	x	
Accipitridae	Tawny Eagle	*Aquila rapax*	x	x
Accipitridae	Verreaux's Eagle	*Aquila verreauxii*	x	
Accipitridae	Wahlberg's Eagle	*Aquila wahlbergi*	x	
Alaudidae	Rufous-naped Lark	*Mirafra africana*	x	
Alcedinidae	African Pgmy Kingfisher	*Ispidina picta*	x	
Alcedinidae	Giant Kingfisher	*Ceryle maxima*	x	
Alcedinidae	Woodland Kingfisher	*Halcyon senegalensis*		x
Anatidae	African Black Duck	*Anas sparsa*	x	
Apodidae	African Black Swift	*Apus barbatus*	x	x
Apodidae	Alpine Swift	*Tachymarptis melba*		x
Apodidae	Little Swift	*Apus affinis*		x
Apodidae	Mottled Swift	*Tachymarptis aequatorialis*	x	x
Apodidae	Sabine's Spinetail	*Rhaphidura sabini*	x	x
Apodidae	Scarce Swift	*Schoutedenapus myoptilus*	x	x
Apopidae	African Palm Swift	*Cypsiurus parvus*	x	

Family Name	English Name	*Scientific Name*	Elgon	Cherengani
Apopidae	White-rumped Swift	*Apus caffer*	x	
Ardeidae	Black-headed Heron	*Ardea melanocephala*	x	
Ardeidae	Grey Heron	*Ardea cinerea*	x	
Ardeidae	Madagascar Squacco Heron	*Ardeola idae*	x	
Bucerotidae	African Grey Hornbill	*Tockus nasutus*	x	
Bucerotidae	Black-and-white Casqued Hornbill	*Bycanistes subcylindricus*		x
Bucerotidae	Black-and-white-casqued Hornbill	*Bycanistes subcylindricus*	x	
Bucerotidae	Crowned Hornbill	*Tockus alboterminatus*	x	x
Bucorvidae	Southern Ground Hornbill	*Bucorvus leadbeteri*		x
Campephagidae	Black Cuckooshrike	*Campephaga flava*	x	x
Campephagidae	Grey Cuckooshrike	*Coracina caesia*		
Campephagidae	Grey Cuckoo-shrike	*Coracina caesia*	x	
Campephagidae	Purple-throated Cuckooshrike	*Campephaga quiscalina*	x	x
Campephagidae	Red-shouldered Cuckoo-shrike	*Campephaga phoenicea*	x	
Capitonidae	Black-billed Barbet	*Lybius guifsobalito*	x	
Capitonidae	Double-toothed Barbet	*Lybius bidentatus*	x	x
Capitonidae	Grey-throated Barbet	*Gymnobucco bonapartei*	x	x
Capitonidae	Moustached Green Tinkerbird	*Pogoniulus leucomystax*	x	x
Capitonidae	Red-fronted Barbet	*Tricholaema diadematus*	x	
Capitonidae	White-headed Barbet	*Lybius leucocephalus*	x	
Capitonidae	Yellow-billed Barbet	*Trachylaemus purpuratus*	x	x
Capitonidae	Yellow-rumped Tinkerbird	*Pogoniulus bilineatus*	x	x
Caprimulgidae	African White-tailed Nightjar	*Caprimulqus natalensis*	x	
Caprimulgidae	Dusky Nightjar	*Caprimulqus fraenatus*	x	
Caprimulgidae	Montane Nightjar	*Caprimulgus poliocephalus*	x	x
Caprimulgidae	Pennant-winged Nightjar	*Macrodipteryx vexillarius*	x	
Caprimulgidae	Plain Nightjar	*Caprimulqus inornatus*	x	
Certhiidae	Dusky Crested Flycatcher	*Trochocercus nigromitratus*	x	
Certhiidae	Red-bellied Paradise Flycatcher	*Terpsiphone rufiventer*	x	
Certhiidae	Spotted Creeper	*Salpornis spilonotus*	x	
Ciconidae	White Stork	*Ciconia ciconia*	x	
Ciconiidae	Woolly-necked Stork	*Ciconia episcopus*		x
Cisticolidae	Black-collared Apalis	*Apalis pulchra*	x	x
Cisticolidae	Black-throated Apalis	*Apalis jacksoni*	x	x
Cisticolidae	Chestnut-throated Apalis	*Apalis porphyrolaema*	x	x
Cisticolidae	Chubb's Cisticola	*Cisticola chubbi*	x	x
Cisticolidae	Grey Apalis	*Apalis cinerea*	x	x
Cisticolidae	Grey-backed Camaroptera	*Camaroptera brachyura*	x	x
Cisticolidae	Grey-capped Warbler	*Eminia lepida*	x	x
Cisticolidae	Tawny-flanked Prinia	*Prinia subflava*	x	x
Cisticolidae	Yellow-breasted Apalis	*Apalis flavida*	x	x
Coliidae	Speckled Mousebird	*Colius striatus*	x	x
Columbidae	African Green Pigeon	*Treron calvus*	x	x
Columbidae	African Olive Pigeon	*Columba arquatrix*		x
Columbidae	Blue-spotted Wood Dove	*Turtur afer*	x	x

Family Name	English Name	*Scientific Name*	Elgon	Cherengani
Columbidae	Dusky Turtle Dove	*Streptopelia lugens*	x	x
Columbidae	Eastern Bronze-naped Pigeon	*Columba delegorguei*	x	x
Columbidae	Emerald-spotted Wood Dove	*Turtur chalcospilos*	x	
Columbidae	Lemon Dove	*Aplopelia larvata*	x	x
Columbidae	Olive Pigeon	*Columba arquatrix*	x	
Columbidae	Red-eyed Dove	*Streptopelia semitorquata*	x	x
Columbidae	Ring-necked Dove	*Streptopelia capicola*	x	x
Columbidae	Speckled Pigeon	*Columba guinea*	x	x
Columbidae	Tambourine Dove	*Turtur tympanistria*	x	x
Coraciidae	Eurasian Roller	*Coracias garrulus*	x	
Coraciidaellers	Broad-billed Roller	*Eurystomus glaucurus*	x	x
Corvidae	Fan-tailed Raven	*Corvus rhipidurus*	x	x
Corvidae	Pied Crow	*Corvus albus*	x	x
Cuculidae	African Emerald Cuckoo	*Chrysococcyx cupreus*	x	x
Cuculidae	Black Cuckoo	*Cuculus clamosus*	x	
Cuculidae	Blue-headed Coucal	*Centropus monachus*	x	
Cuculidae	Diederik Cuckoo	*Chrysococcyx caprius*		x
Cuculidae	Klaas's Cuckoo	*Chrysococcyx klaas*	x	x
Cuculidae	Levaillant's Cuckoo	*Clamator levaillantii*	x	
Cuculidae	Red-chested Cuckoo	*Cuculus solitarius*	x	x
Cuculidae	Senegal Coucal	*Centropus senegalensis*	x	
Cuculidae	White-browed Coucal	*Centropus superciliosus*	x	x
Cuculidae	Yellowbill	*Ceuthmochares aereus*	x	
Dicruridae	Common Drongo	*Dicrurus adsimilis*	x	x
Dicruridae	Square-tailed Drongo	*Dicrurus ludwigii*	x	
Dicruridae	Velvet-mantled Drongo	*Dicrurus modestus*	x	
Emberizidae	Brown-rumped Bunting	*Emberiza affinis*	x	
Estrildidae	Abyssinian Crimsonwing	*Cryptospiza salvadorii*	x	x
Estrildidae	African Firefinch	*Lagonosticta rubricata*	x	x
Estrildidae	Black-and-white Mannikin	*Spermestes bicolor*		x
Estrildidae	Black-crowned Waxbill	*Estrilda nonnula*	x	x
Estrildidae	Common Waxbill	*Estrilda astrild*	x	x
Estrildidae	Grey-headed Negrofinch	*Nigrita canicapillus*	x	x
Estrildidae	Red-cheeked Cordon-bleu	*Uraeginthus bengalus*	x	x
Estrildidae	Red-headed Bluebill	*Spermophaga ruficapilla*	x	x
Estrildidae	Yellow-bellied Waxbill	*Coccopygia quartinia*	x	
Estrilidae	Black-and-white Mannikin	*Lonchura bicolor*	x	
Estrilidae	Black-bellied Firefinch	*Lagonosticta rara*	x	
Estrilidae	Black-headed Waxbill	*Estrilda atricapilla*	x	
Estrilidae	Bronze Mannikin	*Lonchura cucullata*	x	
Estrilidae	Fawn-breasted Waxbill	*Estrilda paludicola*	x	
Estrilidae	Green-backed Twinspot	*Mandingoa nitidula*	x	
Estrilidae	Magpie Mannikin	*Lonchura fringilloides*	x	
Estrilidae	Red-billed Firefinch	*Lagonosticta senegala*	x	x
Eurylaimidae	African Broadbill	*Smithornis capensis*	x	
Falconidae	African Hobby	*Falco cuvieri*		
Falconidae	Common Kestrel	*Falco tinnunculus*	x	
Falconidae	Eurasian Hobby	*Falco subbuteo*	x	
Falconidae	Fox Kestrel	*Falco alopex*	x	

Family Name	English Name	*Scientific Name*	Elgon	Cherengani
Falconidae	Grey Kestrel	*Falco ardosiaceus*	x	
Falconidae	Lanner Falcon	*Falco biarmicus*	x	x
Falconidae	Lesser Kestrel	*Falco naumanni*	x	
Falconidae	Red-footed Falcon	*Falco vespertinus*	x	
Falconidae	Taita Falcon	*Falco fasciinucha*	x	
Fringillidae	African Citril	*Crithagra citrinelloides*	x	x
Fringillidae	Brimstone Canary	*Serinus sulphuratus*	x	
Fringillidae	Oriole Finch	*Linurgus olivaceus*	x	x
Fringillidae	Reichenow's Seedeater	*Crithagra reichenowi*		x
Fringillidae	Streaky Seedeater	*Crithagra striolata*	x	x
Fringillidae	Thick-billed Seedeater	*Serinus burtoni*	x	
Fringillidae	Yellow-crowned Canary	*Serinus flavivertex*	x	x
Fringillidae	Yellow-fronted Canary	*Serinus mozambicus*	x	x
Gruidae	Grey Crowned Crane	*Balearica regulorum*	x	x
Hirundinidae	Angola Swallow	*Hirundo angolensis*	x	x
Hirundinidae	Barn Swallow	*Hirundo rustica*		x
Hirundinidae	Black Saw-wing	*Psalidoprocne pristoptera*	x	x
Hirundinidae	Common House Martin	*Delichon urbica*	x	x
Hirundinidae	Lesser Striped Swallow	*Cecropis abyssinica*		x
Hirundinidae	Mosque Swallow	*Cecropis senegalensis*	x	x
Hirundinidae	Plain Martin	*Riparia paludicola*	x	
Hirundinidae	Red-rumped Swallow	*Cecropis daurica*	x	x
Hirundinidae	Rock Martin	*Ptyonoprogne fuligula*	x	x
Hirundinidae	White-headed Saw-wing	*Psalidoprocne albiceps*		x
Hirundinidae	Wire-tailed Swallow	*Hirundo smithii*		x
Indicatoridae	Cassin's Honeybird	*Prodotiscus insignis*	x	
Indicatoridae	Greater Honeyguide	*Indicator indicator*	x	
Indicatoridae	Least Honeyguide	*Indicator exilis*	x	x
Indicatoridae	Lesser Honeyguide	*Indicator minor*	x	x
Indicatoridae	Scaly-throated Honeyguide	*Indicator variegatus*	x	x
Indicatoridae	Thick-billed Honeyguide	*Indicator conirostris*	x	x
Lanidae	Grey-backed Fiscal	*Lanius excubitoroides*	x	
Lanidae	Lesser Grey Shrike	*Lanius minor*	x	
Lanidae	Mackinnon's Shrike	*Lanius mackinnoni*	x	
Laniidae	Common Fiscal	*Lanius collaris*	x	x
Malaconotidae	Black-fronted Bushshrike	*Chlorophoneus nigrifrons*		x
Malaconotidae	Brown-crowned Tchagra	*Tchagra australis*	x	x
Malaconotidae	Doherty's Bushshrike	*Chlorophoneus dohertyi*	x	x
Malaconotidae	Grey-headed Bush-Shrike	*Malaconotus blanchoti*	x	
Malaconotidae	Lühder's Bush Shrike	*Laniarius luehderi*	x	x
Malaconotidae	Many-coloured Bush-Shrike	*Malaconotus multicolor*	x	
Malaconotidae	Northern Puffback	*Dryoscopus gambensis*	x	x
Malaconotidae	Papyrus Gonolek	*Laniarius mufumbiri*	x	
Malaconotidae	Pink-footed Puffback	*Dryoscopus angolensis*	x	
Malaconotidae	Sooty Boubou	*Laniarius leucorhynchus*	x	
Malaconotidae	Sulphur-breasted Bush-Shrike	*Malaconotus*	x	

Family Name	English Name	*Scientific Name*	Elgon	Cherengani
		sulfureopectus		
Malaconotidae	Tropical Boubou	*Laniarius aethopicus*	x	x
Meropidae	Cinnammon-chested Bee-eater	*Merops oreobates*	x	
Meropidae	Cinnamon-chested Bee-eater	*Merops oreobates*		x
Meropidae	Eurasian Bee-eater	*Merops apiaster*	x	x
Meropidae	Little Bee-eater	*Merops pusillus*	x	
Meropidae	White-throated Bee-eater	*Merops albicollis*	x	
Monarchidae	African Blue Flycatcher	*Elminia longicauda*	x	x
Monarchidae	African Paradise Flycatcher	*Terpsiphone viridis*	x	x
Monarchidae	White-tailed Crested Flycatcher	*Eliminia albonotata*	x	x
Motacillidae	African Pied Wagtail	*Motacilla aguimp*	x	x
Motacillidae	Grassland Pipit	*Anthus cinnamomeus*	x	x
Motacillidae	Grey Wagtail	*Motacilla cinerea*	x	
Motacillidae	Long-billed Pipit	*Anthus similis*		x
Motacillidae	Mountain Wagtail	*Motacilla clara*	x	x
Motacillidae	Plain-backed Pipit	*Anthus leucophrys*	x	
Motacillidae	Sharpe's Longclaw	*Macronyx sharpei*	x	
Motacillidae	Tree Pipit	*Anthus trivialis*	x	x
Motacillidae	Yellow Wagtail	*Motacilla flava*	x	
Muscicapidae	African Dusky Flycatcher	*Muscicapa adusta*	x	x
Muscicapidae	African Grey Flycatcher	*Bradornis microrhynchus*	x	x
Muscicapidae	Cape Robin Chat	*Cossypha caffra*	x	x
Muscicapidae	Common Stonechat	*Saxicola torquatus*	x	x
Muscicapidae	Dusky Blue Flycatcher	*Muscicapa comitata*	x	
Muscicapidae	Gambaga Flycatcher	*Muscicapa gambagae*	x	
Muscicapidae	Northern Anteater Chat	*Myrmecocichla aethiops*	x	x
Muscicapidae	Northern Black Flycatcher	*Melaenornis edolioides*	x	x
Muscicapidae	Pale Flycatcher	*Bradornis pallidus*	x	
Muscicapidae	Semi-collared Flycatcher	*Ficedula semitorquata*	x	
Muscicapidae	Spotted Flycatcher	*Muscicapa striata*	x	
Muscicapidae	Swamp Flycatcher	*Muscicapa aquatica*	x	
Muscicapidae	White-browed Robin Chat	*Cossypha heuglini*	x	x
Muscicapidae	White-eyed Slaty Flycatcher	*Melaenornis fischeri*	x	x
Muscicapidae	White-starred Robin	*Pogonocichla stellata*	x	x
Musophagidae	Black-billed Turaco	*Tauraco schuetti*	x	
Musophagidae	Eastern Grey Plantain-eater	*Crinifer zonurus*	x	
Musophagidae	Great Blue Turaco	*Corythaeola cristata*	x	
Musophagidae	Hartlaub's Turaco	*Tauraco hartlaubi*	x	x
Musophagidae	Ross's Turaco	*Musophaga rossae*	x	
Musophagidae	White-crested Turaco	*Tauraco leucolophus*	x	
Nectariniidae	Amethyst Sunbird	*Chalcomitra amethystina*	x	x
Nectariniidae	Bronze Sunbird	*Nectarinia kilimensis*	x	x
Nectariniidae	Collared Sunbird	*Hedydipna collaris*	x	x
Nectariniidae	Eastern Double-collared Sunbird	*Cinnyris mediocris*	x	
Nectariniidae	Golden-winged Sunbird	*Nectarinia reichenowi*	x	
Nectariniidae	Green Sunbird	*Anthreptes rectirostris*	x	

Family Name	English Name	*Scientific Name*	Elgon	Cherengani
Nectariniidae	Green-headed Sunbird	*Cyanomitra verticalis*	x	x
Nectariniidae	Grey-headed Sparrow	*Passer griseus*	x	x
Nectariniidae	Grey-headed Sunbird	*Anthreptes fraseri*	x	
Nectariniidae	House Sparrow	*Passer domesticus*		x
Nectariniidae	Kenya Rufous Sparrow	*Passer rufocinctus*		x
Nectariniidae	Malachite Sunbird	*Nectarinia famosa*	x	
Nectariniidae	Marico Sunbird	*Cinnyris mariquensis*		x
Nectariniidae	Northern Double-collared Sunbird	*Cinnyris reichenowi*	x	x
Nectariniidae	Olive Sunbird	*Cyanomitra olivacea*	x	x
Nectariniidae	Scarlet-chested Sunbird	*Nectarinia senegalensis*	x	
Nectariniidae	Tacazze Sunbird	*Nectarinia tacazze*	x	x
Nectariniidae	Variable Sunbird	*Cinnyris venustus*	x	x
Numididae	Crested Guineafowl	*Guttera pucherani*	x	x
Numididae	Helmeted Guineafowl	*Numida meleagris*	x	
Oriolidae	African Golden Oriole	*Oriolus auratus*	x	
Oriolidae	Black-headed Oriole	*Oriolus larvatus*	x	
Oriolidae	Cape Rook	*Corvus capensis*	x	
Oriolidae	Montane Oriole	*Oriolus percivali*	x	x
Oriolidae	Western Black-headed Oriole	*Oriolus brachyrhynchus*	x	
Oriolidae	White-naped Raven	*Corvus albicollis*	x	
Paridae	Black Tit	*Parus leucomelas*	x	
Paridae	Dusky Tit	*Parus funereus*	x	
Paridae	White-bellied Tit	*Parus albiventris*	x	x
Phasianidae	Jackson's Francolin	*Francolinus jacksoni*	x	
Phasianidae	Moorland Francolin	*Francolinus psilolaemus*	x	
Phasianidae	Red-winged Francolin	*Francolinus levaillantii*	x	
Phasianidae	Ring-necked Francolin	*Francolinus streptophorus*		
Phasianidae	Scaly Francolin	*Francolinus squamatus*	x	x
Phoeniculidae	Common Scimitarbill	*Rhinopomastus cyanomelas*	x	
Phoeniculidae	Forest Wood-hoopoe	*Phoeniculus castaneiceps*	x	
Phoeniculidae	Green Wood-hoopoe	*Phoeniculus purpureus*	x	
Phoeniculidae	White-headed Wood-hoopoe	*Pheoniculus bollei*	x	x
Picidae	Bearded Woodpecker	*Dendropicos namaquus*	x	x
Picidae	Brown-backed Woodpecker	*Picoides obsoletus*	x	
Picidae	Brown-eared Woodpecker	*Campethera caroli*	x	
Picidae	Buff-spotted Woodpecker	*Campethera nivosa*	x	
Picidae	Cardinal Woodpecker	*Dendropicos fuscescens*	x	x
Picidae	Elliot's Woodpecker	*Mesopicos elliotii*	x	
Picidae	Eurasian Wryneck	*Jynx torquilla*	x	
Picidae	Fine-banded Woodpecker	*Campethera tullbergi*	x	x
Picidae	Grey Woodpecker	*Mesopicos goertae*	x	
Picidae	Nubian Woodpecker	*Campethera nubica*		
Picidae	Red-throated Wryneck	*Jynx ruficollis*	x	x
Picidae	Yellow-crested Woodpecker	*Mesopicos xantholophus*	x	

Family Name	English Name	*Scientific Name*	Elgon	Cherengani
Platysteiridae	Black and White Flycatcher	*Bias musicus*	x	
Platysteiridae	Black-headed Batis	*Batis minor*	x	
Platysteiridae	Black-throated Wattle-eye	*Platysteira peltata*	x	x
Platysteiridae	Chestnut Wattle-eye	*Dyaphorophyia castanea*	x	
Platysteiridae	Chin-spot Batis	*Batis molitor*	x	x
Platysteiridae	Common Wattle-eye	*Platysteira cyanea*	x	
Platysteiridae	Jameson's Wattle-eye	*Dyaphorophyia blissetti*	x	
Ploceidae	Baglafecht Weaver	*Ploceus baglafecht*	x	x
Ploceidae	Black-billed Weaver	*Ploceus melanogaster*	x	x
Ploceidae	Black-headed Weaver	*Ploceus cucullatus*	x	
Ploceidae	Black-necked Weaver	*Ploceus nigricollis*	x	
Ploceidae	Black-winged Red Bishop	*Euplectes hordeaceus*	x	
Ploceidae	Brown-capped Weaver	*Ploceus insignis*	x	x
Ploceidae	Compact Weaver	*Ploceus superciliosus*		
Ploceidae	Dark-backed Weaver	*Ploceus bicolor*	x	
Ploceidae	Fan-tailed Widowbird	*Euplectes axillaris*	x	
Ploceidae	Grosbeak Weaver	*Amblyospiza albifrons*	x	x
Ploceidae	Hartlaub's Marsh Widowbird	*Euplectes hartlaubi*	x	
Ploceidae	Heuglin's Masked Weaver	*Ploceus heuglini*	x	
Ploceidae	Holub,s Golden Weaver	*Ploceus xanthops*	x	x
Ploceidae	Red-headed Malimbe	*Malimbus rubricollis*	x	
Ploceidae	Red-headed Weaver	*Anaplectes rubriceps*	x	
Ploceidae	Spectacled Weaver	*Ploceus ocularis*	x	
Ploceidae	Speke's Weaver	*Ploceus spekei*		x
Ploceidae	Vieillot's Black Weaver	*Ploceus nigerrimus*	x	
Ploceidae	White-winged Widowbird	*Euplectes albonotatus*	x	
Ploceidae	Yellow Bishop	*Euplectes capensis*	x	x
Podicipedidae	Little Grebe	*Tachybaptus ruficollis*	x	
Prionidae	White-crested Helmet-Shrike	*Prionops plumatus*	x	x
Psittacidae	Brown Parrot	*Poicephalus meyeri*	x	
Psittacidae	Red-fronted Parrot	*Poicephalus gulielmi*	x	x
Psittacidae	Red-headed Lovebird	*Agapornis pullaria*	x	
Pycnonotidae	Ansorge's Greenbul	*Andropadus ansorgei*	x	
Pycnonotidae	Cabanis' Greenbul	*Phyllastrephus cabanisi*	x	x
Pycnonotidae	Cameroon Sombre Greenbul	*Andropadus curvirostris*	x	
Pycnonotidae	Common Bulbul	*Pycnonotus barbatus*	x	x
Pycnonotidae	Eastern Nicator	*Nicator gularis*	x	
Pycnonotidae	Fischer's Greenbul	*Phyllastrephus fischeri*	x	
Pycnonotidae	Honeyguide Greenbul	*Baeopogon indicator*	x	
Pycnonotidae	Joyful Greenbul	*Chlorocichla laetissima*	x	
Pycnonotidae	Little Greenbul	*Andropadus virens*	x	
Pycnonotidae	Little Grey Greenbul	*Andropadus gracilis*	x	
Pycnonotidae	Mountain Greenbul	*Andropadus nigriceps*	x	x
Pycnonotidae	Red-tailed Bristlebill	*Bleda syndactyla*	x	
Pycnonotidae	Shelley's Greenbul	*Andropadus masukuensis*	x	
Pycnonotidae	Slender-billed Greenbul	*Andropadus gracilirostris*	x	x

Family Name	English Name	*Scientific Name*	Elgon	Cherengani
Pycnonotidae	Toro Olive Greenbul	*Phyllastrephus baumanni*	x	
Pycnonotidae	Yellow-whiskered Greenbul	*Andropadus latirostris*	x	x
Rallidae	Buff-spotted Flufftail	*Sarothrura elegans*	x	
Rallidae	Striped Flufftail	*Sarothrura affinis*	x	
Rallidae	White-spotted Flufftail	*Sarothrura pulchra*	x	
Remizidae	African Penduline Tit	*Anthoscopus caroli*	x	
Scolopacidae	African Snipe	*Gallinago nigripennis*	x	
Scopidae: Hamerkop	Hamerkop	*Scopus umbretta*	x	x
Strigidae	African Wood Owl	*Strix woodfordii*	x	x
Strigidae	Cape Eagle-Owl	*Bubo capensis*	x	
Strigidae	Pearl-spotted Owlet	*Glaucidium perlatum*	x	
Strigidae	Red-chested Owlet	*Glaucidium tephronotum*	x	
Sturnidae	Greater Blue-eared Starling	*Lamprotornis chalybaeus*	x	
Sturnidae	Bronze-tailed Starling	*Lamprotornis chalcurus*	x	
Sturnidae	Kenrick's Starling	*Poeoptera kenricki*	x	
Sturnidae	Purple Starling	*Lamprotornis purpureus*	x	
Sturnidae	Red-billed Oxpecker	*Buphagus erythrorhynchus*	x	
Sturnidae	Red-winged Starling	*Onychognathus morio*	x	
Sturnidae	Sharpe's Starling	*Cinnyricinclus sharpii*	x	
Sturnidae	Shelley's Starling	*Lamprotornis shelleyi*	x	
Sturnidae	Splendid Starling	*Lamprotornis splendidus*	x	
Sturnidae	Stuhlmann's Starling	*Poeoptera stuhlmanni*	x	
Sturnidae	Superb Starling	*Lamprotornis superbus*	x	
Sturnidae	Violet-backed Starling	*Cinnyricinclus leucogaster*	x	
Sturnidae	Waller's Starling	*Onychognathus walleri*	x	
Sylviidae	African Reed Warbler	*Acrocephalus baeticatus*		x
Sylviidae	Bamboo Warbler	*Bradypterus alfredi*	x	
Sylviidae	Banded Prinia	*Prinia bairdii*	x	
Sylviidae	Bar-throated Apalis	*Apalis thoracica*	x	
Sylviidae	Blackcap	*Sylvia atricapilla*	x	x
Sylviidae	Black-faced Rufous Warbler	*Bathmocercus rufus*	x	
Sylviidae	Black-headed Apalis	*Apalis melanocephala*	x	
Sylviidae	Boran Cisticola	*Cisticola bodessa*	x	
Sylviidae	Brown Parisoma	*Parisoma lugens*	x	x
Sylviidae	Brown Woodland Warbler	*Phylloscopus umbrovirens*	x	x
Sylviidae	Buff-bellied Warbler	*Phyllolais pulchella*	x	
Sylviidae	Buff-throated Apalis	*Apalis rufogularis*	x	
Sylviidae	Cinnamon Bracken Warbler	*Bradypterus cinnamomeus*	x	x
Sylviidae	Dark-capped Yellow Warbler	*Chloropeta natalensis*	x	
Sylviidae	Evergreen Forest Warbler	*Bradypterus lopezi*		x
Sylviidae	Foxy Cisticola	*Cisticola troglodytes*	x	
Sylviidae	Garden Warbler	*Sylvia borin*	x	

Family Name	English Name	*Scientific Name*	Elgon	Cherengani
Sylviidae	Green Crombec	*Sylvietta virens*	x	
Sylviidae	Green Hylia	*Hylia prasina*	x	
Sylviidae	Green-backed Eremomela	*Eremomela pusilla*	x	
Sylviidae	Hunter's Cisticola	*Cisticola hunteri*	x	
Sylviidae	Little Rush Warbler	*Bradypterus baboecala*	x	
Sylviidae	Mountain Yellow Warbler	*Chloropeta similis*	x	x
Sylviidae	Northern Crombec	*Sylvietta brachyura*	x	
Sylviidae	Olivaceous Warbler	*Hippolais pallida*	x	
Sylviidae	Olive-green Camaroptera	*Camaroptera chloronota*	x	
Sylviidae	Rattling Cisticola	*Cisticola chiniana*	x	
Sylviidae	Red-faced Cisticola	*Cisticola erythrops*	x	
Sylviidae	Red-faced Crombec	*Sylvietta whytii*	x	
Sylviidae	Siffling Cisticola	*Cisticola brachypterus*	x	
Sylviidae	Singing Cisticola	*Cisticola cantans*	x	
Sylviidae	Stout Cisticola	*Cisticola robustus*	x	
Sylviidae	Trilling Cisticola	*Cisticola woosnami*	x	
Sylviidae	Turner's Eremomela	*Eremomela turneri*	x	
Sylviidae	Uganda Woodland Warbler	*Phylloscopus budongoensis*	x	
Sylviidae	Whistling Cisticola	*Cisticola lateralis*	x	
Sylviidae	White-browed Crombec	*Sylvietta leucophrys*	x	x
Sylviidae	Willow Warbler	*Phylloscopus trochilus*	x	x
Sylviidae	Yellow-bellied Hyliota	*Hyliota flavigaster*	x	
Threskiornidae	Hadada Ibis	*Bostrychia hagedash*	x	x
Timaliidae	African Hill Babbler	*Pseudoalcippe abyssinica*	x	x
Timaliidae	Black-lored Babbler	*Turdoides melanops*	x	
Timaliidae	Brown Illadopsis	*Illadopsis fulvescens*	x	
Timaliidae	Grey-chested Illadopsis	*Kakamega poliothorax*	x	
Timaliidae	Mountain Illadopsis	*Illadopsis pyrrhoptera*	x	x
Timaliidae	Pale-breasted Illadopsis	*Illadopsis rufipennis*	x	
Timaliidae	Rufous Chatterer	*Turdoides rubiginosa*		x
Timaliidae	Scaly-breasted Illadopsis	*Illadopsis albipectus*	x	
Trogonidae	Bar-tailed Trogon	*Apaloderma vittatum*	x	
Trogonidaeogons	Narina Trogon	*Apaloderma narina*	x	x
Turdidae	Abyssinian Ground Thrush	*Zoothera piaggiae*	x	
Turdidae	African Thrush	*Turdus pelios*	x	
Turdidae	Alpine Chat	*Cercomela sordida*	x	
Turdidae	Blue-shouldered Robin-Chat	*Cossypha cyanocampter*	x	
Turdidae	Brown-backed Scrub Robin	*Cercotrichas hartlaubi*	x	
Turdidae	Brown-chested Alethe	*Alethe poliocephala*	x	
Turdidae	Equatorial Akalat	*Sheppardia aequatorialis*	x	
Turdidae	Equatorial Akalat	*Sheppardia aequatorialis*	x	
Turdidae	Forest Robin	*Stiphrornis erythrothorax*	x	
Turdidae	Grey-winged Robin	*Sheppardia polioptera*	x	
Turdidae	Little Rock Thrush	*Monticola rufocinerea*	x	
Turdidae	Olive Thrush	*Turdus olivaceus*	x	
Turdidae	Red-capped Robin-Chat	*Cossypha natalensis*	x	

Family Name	English Name	*Scientific Name*	Elgon	Cherengani
Turdidae	Snowy-headed Robin-Chat	*Cossypha niveicapilla*	x	
Turdidae	White-starred Robin	*Pogonocichla stellata*	x	x
Tytonidae	Barn Owl	*Tyto alba*	x	
Upupidae	Hoopoe	*Upupa epops*	x	x
Viduidae	Pin-tailed Whydah	*Vidua macroura*	x	x
Zosteropidae	African Yellow White-eye	*Zosterops senegalensis*		x
Zosteropidae	Montane White-eye	*Zosterops poliogaster*	x	
Zosteropidae	Yellow White-eye	*Zosterops senegalensis*	x	

Appendix 2: Wetland associated Reptiles and Amphibians recorded in Mt Elgon-Cherangany ecosystem

Amphibians

Species	**Mt Elgon**	**Cherengany**
1. Torrent frog *Arthroleptides dutoiti*	X	
2. Northern clawed frog *Xenopus borealis*	X	
3. Lake Victoria clawed frog *Xenopus victorianus*	X	X
4. Kisolo toad *Sclerophrys* cf. *kisoloensis*	X	X
5. Guttural toad *Sclerophrys gutturalis*	X	
6. Kerinyaga toad *Sclerophrys kerinyagae*	X	
7. Senegal kasina *Kassina senegalensis*	X	
8. Common reed frog *Hyperolius v. viridiflavus*	X	
9. Grauer's puddle frog *Phrynobatrachus* cf. *graueri*	X	X
10. Upland puddle Frog *Phrynobatrachus keniensis*	X	
11. Schefler's puddle frog *Phrynobatrachus schefleri*	X	
12. Puddle frog *Phrynobatrachus* sp.	X	
13. Nutt's river frog *Amietia nutti*	X	X
14. De Witte's river frog *Amietia wittei*	X	
15. Mascarene ridged frog *Ptychadena mascareniensis*	X	X
16. Anchieta's ridged frog *Ptychadena anchietae*	X	X
17. Small ridged frog *Ptychadena taenioscelis*	X	
18. Three-striped grass frog *Ptychadena porosissima*	X	
19. 'Banana frog' *Afrixalus quadrivittatus*	X	
20. Kivu reed frog *Hyperolius kivuensis*	X	
21. Sharp-nosed reed frog *Hyperolius acuticeps*		X
22. Cinnamon-belied reed frog *Hyperolius cinnamommeoventris*		X

Reptiles

Species	**Mt Elgon**	**Cherengany**
23. Helmetted terrapin *Pelomedusa subrufa*	X	
24. Brook's gecko *Hemidactylus brooki*	X	
25. Elgon forest gecko *Cnemaspis elgonensis*	X	
26. House Gecko *Hemidactylus angulatus*		X
27. Kenya dwarf gecko *Lygodactylus keniensis*	X	
28. Striped skink *Trachylepis striata*	X	X
29. Five-lined skink *Trachylepis quinquetaeniata*	X	X
30. Variable skink *Trachylepis varia*	X	X
31. Alpine meadow skink *Trachylepis irregularis*		X
32. Bayon's skink *Trachylepis bayoni*		X
33. Long-tailed sand lizard *Latastia longicaudata*		X
34. Mt Elgon lizard *Adolfus masavensis*	X	X
35. Jackson's forest lizard *Adolfus jacksoni*	X	X
36. Peter's writhing skink *Mochlus afrum*	X	

37. Blue-headed tree agama *Acanthocerus atricollis*	X	X
38. Red-headed rock agama *Agama lionotus*	X	X
39. Montane side stripped Chameleon *Trioceros ellioti*	X	X
40. Pokot Chameleon *Trioceros nyirit*		X
41. Von Höhnel's chameleon *Trioceros hoehnelii*	X	X
42. Slender chameleon *Chamaeleo gracilis*	X	
43. Yellow-throated plated lizard *Gerrhosaurus flavigularis*		X
44. Don Broadley's plated lizard *Broaadleysaurus major*		X
45. Savanna monitor *Varanus albigularis*		X
46. Nile monitor *Varanus niloticus*		X
47. Lionate blind snake *Afrotyphlops leneolatus*	X	
48. Central African rock python *Python sebae*	X	
49. Cape file snake *Gonionotophis capensis*	X	
50. Battersby's green snake *Philothamnus battersbyi*	X	X
51. Jackson's tree snake *Thrasops jacksoni*	X	X
52. South-Eastern green snake *Philothamnus hoplogaster*	X	
53. Northern stripe-bellied sand snake *Psammophis sudanensis*	X	X
54. White lipped snake *Crotaphopeltis hotamboea*	X	
55. Boomslang *Dyspholidus typus*	X	X
56. Olive sand snake *Psammophis mosambicus*	X	
57. Large-Eyed Cat Snake *Telescopus dhara*		X
58. Common house snake *Boaedon fuliginosus*	X	X
59. Common egg eater *Dasypeltis scabra*	X	
60. Montane egg eater *Dasypeltis atra*	X	
61. Cape wolf snake *Lycophidion capense*	X	
62. Forest wolf snake *Lycophidion ornatum*	X	X
63. Common Slug Eater *Duberria lutrix*		X
64. East African garter snake *Elapsoidea loveridgei*	X	
65. Forest cobra *Naja melanoleuca*	X	X
66. Black necked spitting cobra *Naja nigricollis*	X	
67. Gold's tree cobra *Pseudohaje goldii*	X	
68. Black mamba *Dendaspis polylepis*	X	
69. Puff adder *Bitis arietans*	X	
70. Large eyed green tree snake *Rhamnophis aethiopissa*	X	

Appendix 3: Mt. Elgon-Cherengany Ecosystem Questionnaire

Background Information

1. Date……
2. Name of interviewee (optional)……
3. District…….Location……Sub location……
4. Gender (a) Male (b) Female
5. Age
   a) Less than 25 yrs b) 25 to 50yrs c) Above 50yrs
6. Main pre-occupation
   (a) Farming
   (b) Business
   (c) Wage employment
   (d) Others specify…….

I. Perception of Current Status of Wetlands/Springs & Use

Are there any **Wetlands** or **Springs** around?

YES/NO ……..

If **YES** what is its local name ……

What do you consider as its benefits to the local community?

……

……..

……..

Are there any commercial activities around the wetland/spring? If **YES** what type of activities

……

……

What do you perceive as the current status of the wetland/spring? Well conserved **OR** deteriorated

……..

II. Conservation Measures

If the wetland/spring is well conserved what factors contributed to its conservation?

…….…….....

.....

.....

If deteriorated what do you consider as the major threats to its existence?

……

……

……

Are there any conservation efforts for the said wetland/spring? **YES/NO** .....

If **YES** by who? Locals, Govt, NGOs etc.

……..……

……..

What do you perceive to be the best conservation strategies?

……

……

How best can the locals be involved in the conservation efforts?

……

……

……

III. Traditional Knowledge

Is there any traditional/indigenous knowledge about the wetland/spring that you are aware of?

YES/NO ……...

If **YES** how can it be useful for the conservation of the wetland/spring?

……

……